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ABSTRACT

Intended to be a self-instructional manual for television repair technicians, this manual consists primarily of 45 separate sections, each of which describes a symptom of faulty television sets and the troubleshooting procedures appropriate for it. The symptoms addressed are dead set, no raster, no vertical deflection, no vertical synchronization, insufficient vertical deflection and poor vertical linearity, fold-over, improper synchronization, no horizontal synchronization, part of image is out of synchronization, insufficient horizontal deflection, wavy vertical edges, horizontal trigger oscillation, no horizontal deflection, no image, weak contrast, no reception in a particular channel, image interference from other stations, white dots on the screen, no color, no color synchronization, improper color, loss of one or two primary colors, weak color, no uniform color strength, poor color purity, poor convergence all over the screen, poor convergence in the sides of the screen, colored raster, color smear, fine color noise, poor brightness, a bright spot in the middle of the screen, appearance of the retrace lines, poor focus, periodic raster movement, black horizontal bars on the screen, warped raster, no sound, buzzing sound, distorted sound, noisy sound, and color noise. The circuit diagrams that appear and the procedures that are recommended are based mainly on the NTSC color transmission system, although they may be adaptable for technicians in the PAL and SECAM region. (CML)

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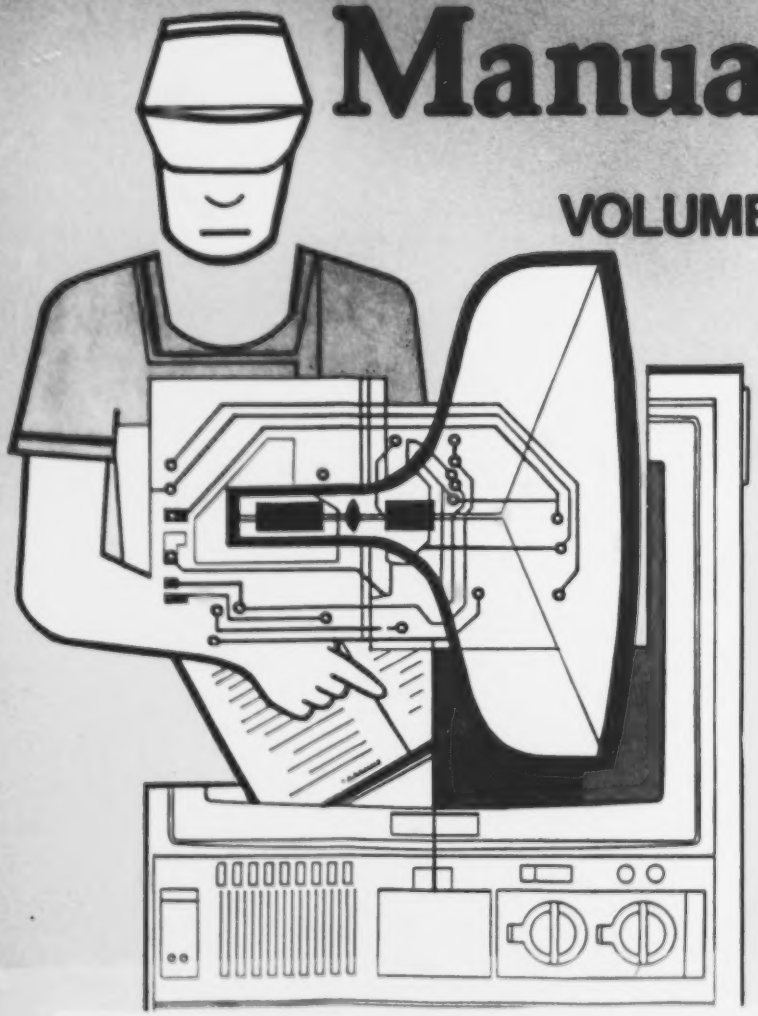
VOLUME 1



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TV Trouble-shooting Manual

VOLUME 1

BY MASAAKI MUKAI AND RYOZO KOBAYASHI

ASIAN AND PACIFIC SKILL DEVELOPMENT PROGRAMME
INTERNATIONAL LABOUR OFFICE
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Introduction

At the APSDEP Regional Workshop on Skill Testing of Radio and TV Mechanics, held in Bangkok, Thailand, 24-26 November 1982, it was recommended that APSDEP produce a training package on TV repair and publish a trouble-shooting manual. The result is the present book, *TV Trouble-shooting Manual*, by Messrs M. Mukai and R. Kobayashi. It lists 45 symptoms and their trouble-shooting procedures.

This manual is a translation of a part of an original textbook entitled *Terebi Shuuri* by Mr Masaaki Mukai of Nippon Hooso Shuppan Kyookai.

Trouble-shooting procedures and circuit diagrams used in this manual are based mainly on the NTSC colour transmission system. The manual is written in such a way that technicians in the PAL and SECAM region can easily adopt the trouble-shooting procedures.

APSDEP is grateful to the Japan International Cooperation Agency (JICA) for its financial support. It also thanks Mr Joey Posadas of the University of the Philippines and Miss Mercy de Regra of the National Manpower and Youth Council for helping Mr Kobayashi.

RONY V. DIAZ
Director

Preface

Throughout the manual, circuit diagrams and their associated wave-forms, voltage and resistances are given for reference, and to complement the discussions about trouble-shooting fundamentals, procedures and techniques.

Trouble-shooting procedures and circuit diagrams used in this manual are based mainly on the NTSC colour television transmission system. Troubles—things that can go wrong with the set—are classified into 45 typical symptoms.

Although there are distinct differences in the colour decoder circuits in the NTSC, PAL and SECAM TV transmission systems, most of the symptoms discussed in this manual are common among them. The flow chart, logic and trouble-shooting procedures themselves are general; so is the processing of colour TV signal. The manuals are written such that technicians working on the PAL-SECAM system can easily adopt the repair procedure.

When actually trouble-shooting, the technician should always refer to the schematic diagram of the defective receiver. The technician is advised to have on hand the circuit diagram of the defective receiver. Trouble-shooting without it will be difficult.

This manual is also recommended as training material for TV-repair technicians. The most efficient trouble-shooting procedures can be discussed while going over the classified trouble symptoms.

SOME TIPS

1 A good repair-man conducts a prompt diagnosis of the trouble symptom and repairs the defective set in the shortest possible time. Do *not* trouble-shoot a circuit unless you have determined what stage in it is defective. When trouble-shooting a particular stage, bear in mind its function. This will help you diagnose its operation—and find the defective stage and the defective component.

2 Wear cotton gloves while trouble-shooting, to avoid electrical shock. Also note that, especially in tropical countries, sweat on the hands may later on cause corrosion.

3 Never remove a component from the circuit unless you have confirmed it to be defective. In some cases, when you suspect a component to be defective, you may find it necessary to disconnect one of its terminals, or the component itself, from the circuit for testing. Before doing this, first measure voltage or observe wave-forms. If a reading is wrong, analyse the circuit and check which component may be causing the trouble and should be tested.

4 Discharge large capacitors and the stored charge in the cathode-ray tube (CRT) to avoid dangerous shocks—especially when trouble-shooting the CRT circuits or the horizontal output circuit. The aquadag (a conductive coating) layer inside the CRT, which connects the anode to the anode button, and the aquadag layer outside the CRT, which is connected to ground, are separated by the glass wall

of the CRT. These form a high-voltage capacitor. If the charge stored in this capacitor is not discharged, it can give off strong electrical shocks if touched.

5 If the trouble symptom is caused by ageing components, the defective component is usually one of them. But in some cases, especially in high-power-handling circuits, a defective component may cause other components to malfunction.

6 It is important for the technician to know the usual defects of components. For example, capacitors usually become leaky, shorted or open. Resistors increase their resistance when they become defective.

Semiconductors such as transistors usually become open or shorted. Unlike tubes, transistors do not age. The semiconductors are either good or bad.

7 When trouble-shooting integrated circuits (ICs), do not remove the IC from the PCB, simply because you suspect it is defective. To help you diagnose the function of the IC, secure a circuit diagram from the manufacturer. It would be even better if you have available a diagram showing the internal connection of the IC.

Most of the ICs used in TV and radio receivers are linear ICs, and their internal stages are directly connected. This means voltage at the several IC pins is affected by a single trouble within the IC.

When analysing the IC circuit, first check the IC pin voltage where the B+ and other supply voltage are supplied. If the voltage there proves to be normal, check the pin voltage where the supply voltage or external power source is not connected. If this voltage is wrong, suspect a breakdown in the IC.

Use de-soldering tools to remove the IC, to avoid damage to the printed circuit board (PCB).

8 Always be careful about the *polarity* of the components when replacing them. Unlike the electrolytic capacitors in tube circuits, electrolytic capacitors used in transistor or integrated circuits have only low voltages. The danger of an explosion therefore is not immediate—but it will surely come after sometime.

9 Don't remove components from the PCB. Every component has a specific function in the circuit; there is absolutely no wasted component. Always analyse the specific function of every component in the circuit.

10 Don't replace an opened fuse or burned resistor unless you have corrected the trouble or the cause of it.

11 Faulty mechanical switches often confuse repair technicians. Trouble is often observed in the exposed mechanical switch circuit, such as the simple slide switch, the complicated switch circuit in a videocassette recorder (VCR), etc. As in a VCR, there are many switches used. Many different functions are switched. Thus the chances of faulty contact are more frequent; and these faulty contacts cause various kinds of defects. When trouble-shooting the mechanical switch circuit, always suspect a faulty contact, rather than defective electronic components.

These switches become faulty because they are not often used; or because they are always positioned to one side. This means the contacts of the switches

often deteriorate—because of sparks or rust.

12 In the case of transistors connected in a series, or transistor pairs (such as the vertical or sound output transistor pairs), when one of them is defective, both transistors should be replaced. Do *not* replace only one of them.

13 When replacing power transistors, such as the ones used in the horizontal output stage, the replacement should have the same h_{fe} rating. Otherwise, the amplitude of the horizontal output signal may decrease and cause another problem, such as insufficient raster width.

14 If you find a blown fuse, first find the cause of the short circuit before replacing it. If you cannot find the cause, replace the blown fuse with a fuse of the same rating.

If the glass of the blown fuse is clear, or if the conductor inside the fuse is neatly cut, assume an overload has caused it. In this case, the trouble may be complicated. If the glass of the blown fuse is black, or if the conductor inside has melted, assume the short circuit is due to extremely strong electric current.

15 Use needle-pointed probes for better contact and to avoid short-circuiting nearby components.

16 While trouble-shooting, study the schematic diagram carefully. Always compare with the actual measured voltage in the set the voltage indicated on the circuit diagram. A difference of around 10 per cent between the measured voltage and the *ideal* diagrammed voltage is tolerable, but *not* more than 10 per cent.

17 When measuring resistances in the circuit, make sure that power is not being supplied to the circuit and that stored charges in capacitors are properly discharged. Failure to do so can damage the volt-ohm-milliammeter (VOM) *and* the circuit, due to the low resistance of the ohmmeter.

18 The functions and the characteristics of the VOM should be fully understood to maximise its application. During trouble-shooting, the different functions of the VOM should be wisely used. For example, the voltage measurement ranges of a VOM can be used as a variable resistance box, since the internal resistance varies with its voltage range. The VOM can also be used as a kind of signal injector, by setting it at the ohmmeter range. Always maximise the use of whatever instruments and tools are available.

19 While using a VOM for in-circuit resistance measurement, always exchange the setting of positive and negative probes. Take the higher meter reading as the approximate resistance.

In a VOM the internal batteries are connected in a series when it is set for resistance measurement. These batteries may give the forward bias voltage to the circuit and indicate lower resistance. Of course, it will be more accurate to measure resistance by cutting one end of the component.

20 Many repair technicians dream of having a complete set of electronic measuring and testing equipment. However, not all of these tools are useful all the time. Those really needed for servicing home appliances are few. Generally, there

are two types of measuring equipment—one is for servicing and the other is for alignment. For servicing home appliances, there really is no need to buy aligning equipment such as a marker generator and a sweep generator.

21 Whenever you use measuring equipment, first read carefully the user's manual. Analyse carefully the readings or measurements you have obtained. Particularly when you use an oscilloscope, observe the wave-form carefully and analyse it. Some technicians feel happy when they see a wave-form—not caring whether it is right or wrong. It is important to know what kind of wave-form to expect, before going into the actual wave-form observation. Never observe high pulses greater than the maximum rating of the oscilloscope, otherwise its input circuit will be damaged.

22 When you have a chance to buy or use an oscilloscope, select one that has trigger functions. This oscilloscope is usually called a synchroscope. An oscilloscope with a vertical input sensitivity of around 15 MHz is required for trouble-shooting the chroma section of colour TV receivers.

23 Use soldering irons with the proper power rating to prevent the components and the circuit board from being overheated and damaged. The soldering-iron tips should be clean and preferably slim. Soldering guns are not recommended for beginners, since it is difficult to keep their temperatures constant.

24 Use proper tools and soldering aids when trouble-shooting printed circuit boards. Ground the soldering iron to avoid damaging ICs and transistors.

25 Dry solder joints are hard to detect. However, when they are found or suspected, remove the components from the PCB; then file or clean the leads and solder the joints back. Reheating dry joints with a new soldering lead is another remedy.

When resoldering, make sure you do *not* overheat the components. Overheating the PCB may cause the copper layer on it to warp and peel off.

26 Select a soldering iron with the rating appropriate for the particular application. Many technicians use a low-power soldering iron when trouble-shooting solid-state circuits. It is true most trouble-shooting books advise using a low-power soldering iron. But heating the joint for a considerable period may cause other problems. Always select the proper power rating of soldering irons, to do the soldering job quickly.

27 A good repair technician never touches the alignment of a TV set when he trouble-shoots. The set is properly aligned and sealed at the factory, and the technician should not touch this when he repairs the set. Even if re-alignment is needed, it is hard to set up the condition of the circuit similar to that of the manufacturers'. Thus, precision alignment can *not* be performed by the service technicians.

Unlike mechanical or automotive components, TV sets will never be mechanically misaligned due to vibration. Thus, except in trouble-shooting circuitry, technicians should not suspect misalignment of the set—except when the set has been tampered with by other technicians.

1 Dead set

This symptom is characterised by a completely inoperative (dead) set.

Cause: This symptom is usually caused by a breakdown in the power-supply circuit. In most modern receivers (transistorised and/or IC), it may also be caused by a breakdown in the horizontal deflection circuits (horizontal oscillator, pre-drive or drive circuits.) This is because the supply voltages for the tuner, video intermediate frequency (VIF), video amplifier, sound intermediate frequency (SIF) and vertical output circuit are usually supplied by the horizontal output circuit.

In some colour TV sets, the filament voltage of the CRT is also supplied by the horizontal deflection circuit. In such a case, if the horizontal deflection circuit is defective, the filament of the CRT will not heat up, and the cathode will not emit electrons. Refer to the circuit diagram for an accurate diagnosis of the defective receiver's power-supply set-up.

TROUBLE-SHOOTING PROCEDURE

a **Solid-state circuits**

Switch on the receiver and check whether the pilot lamp is on, or if the filament of the CRT is glowing. If not, check possible short circuit before the rectifier circuit such as fuses, the power cord and the power switch.

If the pilot lamp is on or the filament of the CRT is glowing, check the B+ supply voltage for the horizontal deflection circuit. If the B+ voltage is zero or is very low, check the rectifier and the voltage-regulator circuits. If the B+ voltage supplied to the horizontal deflection circuit is normal, trouble-shoot the horizontal deflection circuit. Refer to Fig. 1-1 for the trouble-shooting flow chart.

1 ***Trouble-shooting the power-supply circuit***

a If the fuses are open, locate possible short circuits such as shorted rectifier diodes or filter capacitors.

b Measure the output voltage (E2 in Fig. 1-2) of the power-supply circuit to confirm whether the rectifiers and the voltage regulator circuit are normal. If the output voltage is zero, check fuse F3. Disconnect the load at the output if necessary, while measuring the output voltage.

2 ***Trouble-shooting the horizontal deflection circuit***

For fast trouble-shooting, start from the initial stages and work towards the final stages. When trouble-shooting a particular stage, keep in mind the function of that stage for a better diagnosis of its operation. In trouble-shooting the horizontal deflection stage, it is important to check the oscillation of the horizontal oscillator circuit. The exact condition of the circuit can be known by observing the wave-forms at the horizontal oscillator transistor.

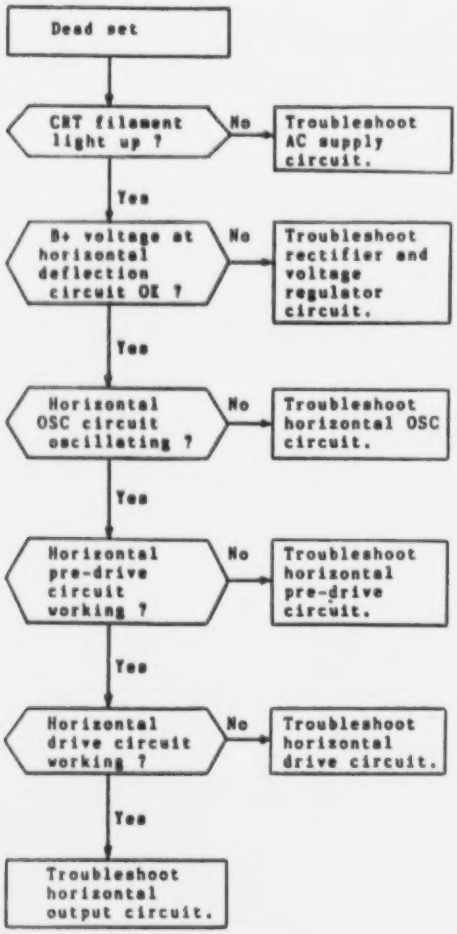
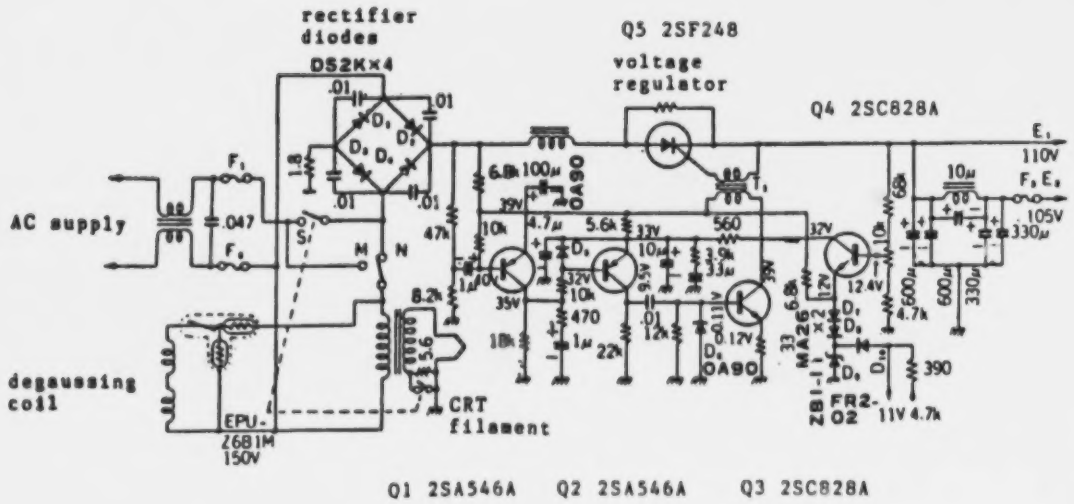


Fig. 1-1
Trouble-shooting flow chart for dead set

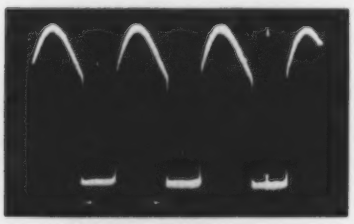
If an oscilloscope is available, observe the output wave-form of the horizontal oscillator transistor (Q3), pre-drive, transistor (Q4) and the drive transistor (Q5) in the circuit shown in Fig. 1-3. Refer to Picture 1-1 for the normal waveforms. After identifying the defective stage, use a VOM to pinpoint the defective component. The normal voltages at several points in the circuit are given in the diagram shown in Fig. 1-3.

It is easier and more practical to use a VOM—although it is not as accurate as the oscilloscope—for checking the operation of the horizontal deflection circuit. Measure the AC component of the horizontal deflection sawtooth wave at the base and collector of the transistors in the horizontal deflection circuit.

In measuring the AC component of the sawtooth wave, set the VOM to the proper AC range and connect a capacitor (around 0.1 to 1 uF) in series to the positive probe. In some Japanese manufactured VOMs, the output terminal is

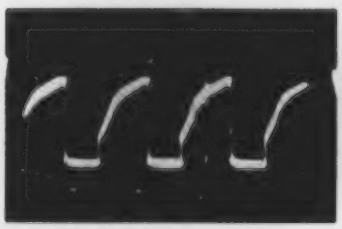


Picture 1-1
Example wave-forms of horizontal deflection circuit

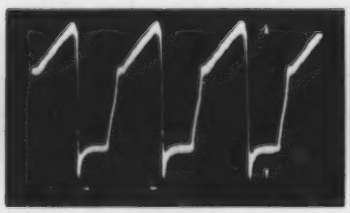


(a) collector, horizontal oscillator

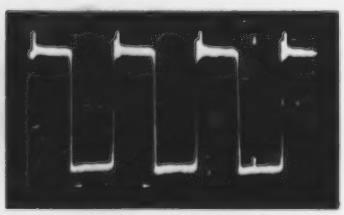
(b) base, horizontal pre-drive



(c) collector, horizontal pre-drive



(d) base, horizontal drive



(e) collector, horizontal drive

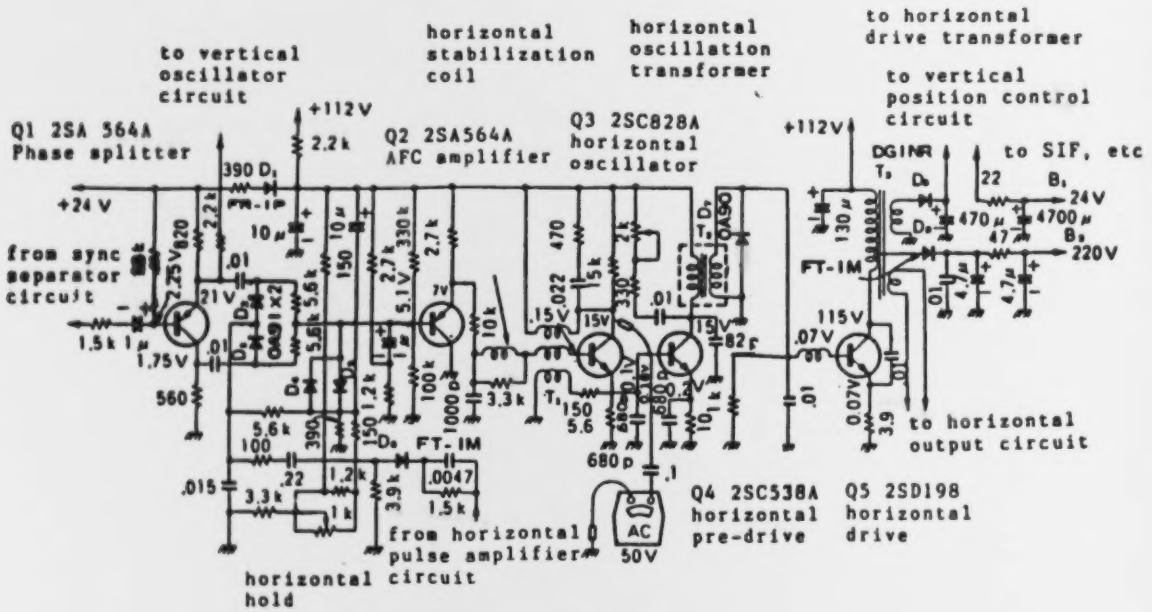


Fig. 1-3
Horizontal oscillator and horizontal pre-drive circuit

available for this function. When this terminal is used, a 0.1 uF capacitor within the VOM is connected in series to the positive probe.

The actual value of the AC component of the sawtooth signal varies from set to set. Furthermore, the voltage readings are not exact. However, if the reading obtained in a certain stage is incorrect, you can tell which stage is defective. This could be confirmed by using an oscilloscope if necessary.

The readings obtained for the circuit in Fig. 1-3 during normal operation are given in Chart 1-1. In actual cases, if the horizontal deflection circuit of a receiver is operating properly, it is still advisable to measure and tabulate these voltages for later reference.

Chart 1-1
AC voltage at horizontal pre- and drive circuit

measured at	AC voltage
Q4 base	1.5 V
Q4 collector	18 V
Q5 base	1.9 V
Q5 collector	225 V

If any of the measured voltages is suspected to be incorrect and the defective stage is located, pinpoint the defective component with the aid of a VOM, concentrating on the transistor and the components surrounding it. Use the VOM wisely by measuring resistances and voltages. If any reading is considered incorrect, analyse the circuit to find out which component could be causing the trouble. Never remove a component from the PCB unless you suspect it to be defective.

If the horizontal deflection circuit is observed to be operating properly but the HV (high voltage) for the anode is absent, check the high-voltage rectifier diodes and the continuity of the windings of the HOT (Horizontal Output Transformer) or HVT (High-Voltage Transformer).

Technical memo

1 The oscillation of the oscillator circuit can also be checked by measuring the base-collector junction voltage (Vbc) of the horizontal oscillator transistor.

2 In colour receivers, a dead-set symptom may occur even if the power supply and the horizontal deflection circuits are operating properly. In this case, a defective first video amplifier circuit may be causing the symptom. A breakdown in the first video amplifier circuit may drive the cathode voltage of the CRT above the cut-off level and affect the automatic gain control (AGC) circuit, which could disable the tuner and the VIF circuits. Thus, the sound and picture reproductions are disabled.

This condition is easily confirmed by placing the back of the hand near the surface of the CRT screen. If the pilot lamp is on and a static charge could be felt—meaning the high voltage is normal—a defective first video amplifier circuit may be causing the symptom.

b IC circuits

The trouble-shooting flow charts for an IC receiver and a solid-state receiver are similar. An example of a horizontal oscillator IC circuit is shown in Fig. 1-4 and the method for trouble-shooting this circuit will be discussed.

First, find out the pin configuration of the IC; then observe the output wave-form at the output pin. If an oscilloscope is not available, the AC component of horizontal sawtooth wave can be checked with a VOM, as discussed previously. For the circuit in Fig. 1-4, the output wave-form of IC501 (uPC49C) can be taken from pin no. 2. Besides the output wave-form, the other pin wave-forms should also be observed, to give you a better idea of the operation of the circuit. The proper pin wave-forms, pin voltages and resistances are given in Fig. 1-5. If any of the observed wave-forms is incorrect, measure the pin resistances to pinpoint the defective component.

Since the ICs used in colour TV sets are linear and the stages within the IC chip are directly coupled, a single defective component in the external circuit of a single stage in the IC chip may vary several pin voltages and confuse technicians when diagnosing. Thus it is best to study the schematic diagram and see how the stages may affect each other. In most cases, the defective component can be identified by measuring the voltages of the pins not connected to exter-

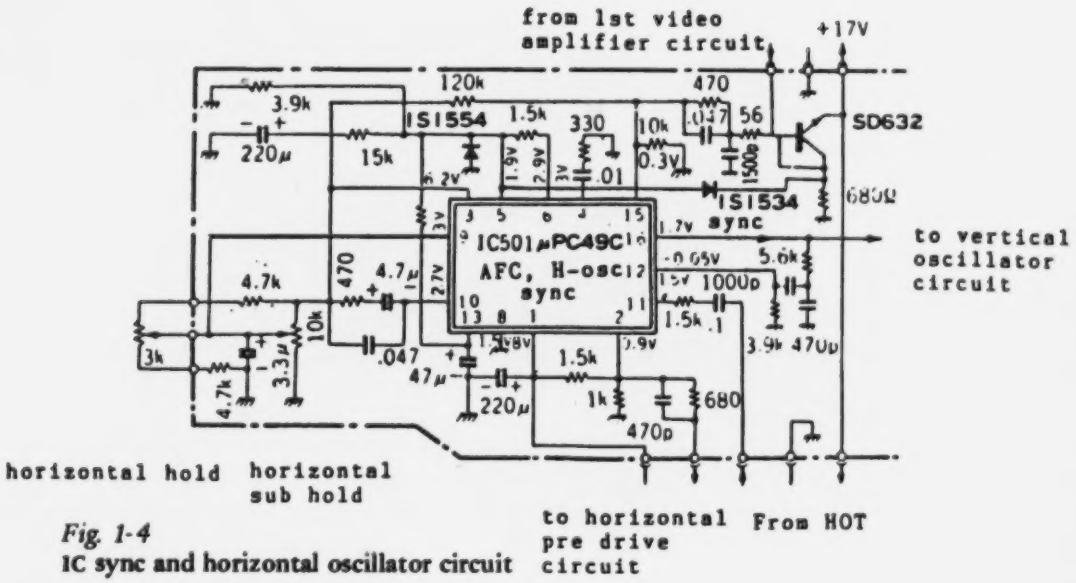


Fig. 1-4
IC sync and horizontal oscillator circuit

nal power sources.

Pin voltages and resistances are IC and circuit-dependent. Hence, when trouble-shooting an IC circuit, you must get the diagram of the defective set from the manufacturer; trouble-shooting without it will prove useless. When testing the continuity or measuring the resistance of a circuit component, disconnect one of its terminals from the PCB if necessary.

The IC should be replaced only when its surrounding components have all been confirmed to be in good condition.

Reference

In transistorised or IC receivers, a defective horizontal deflection circuit can also cause a dead-set symptom, because the supply voltage of the SIF circuits is usually taken from it. Thus, if the horizontal deflection circuit is defective, both the raster and sound are lost. See Fig. 1-6 for an example of a receiver's supply voltage set-up.

Fig. 1-3 shows a typical circuit, where the voltage of the SIF circuits is supplied by the horizontal deflection circuit. The pulses generated by the horizontal drive transformer (T3) are rectified by D8 and then supplied to the SIF circuits. When a breakdown occurs in the horizontal deflection circuit, the high-voltage supply for the CRT and the supply voltage of the SIF circuits are lost. This results in a dead set.

Sometimes the supply voltage of the SIF circuits is taken from the horizontal output transformer (HOT). Fig. 1-7 shows an example of this. Thus a defective horizontal output circuit will also cause a dead-set symptom.

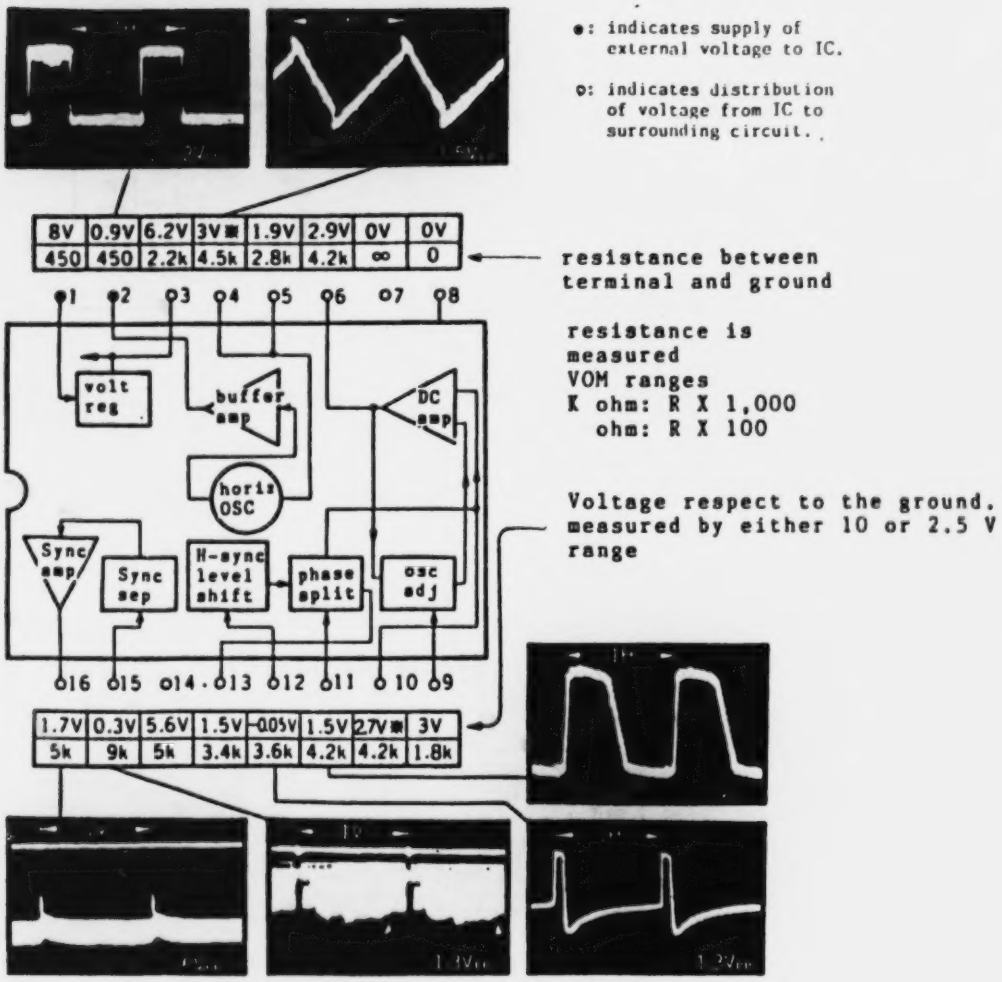

●: indicates supply of external voltage to IC.
○: indicates distribution of voltage from IC to surrounding circuit.
8V 0.9V 6.2V 3V■ 1.9V 2.9V 0V 0V
450 450 2.2k 4.5k 2.8k 4.2k ∞ 0
resistance between terminal and ground
●1 ●2 ○3 ○4 ○5 ○6 ○7 ○8
volt reg
buffer amp
DC amp
horiz OSC
Sync amp
Sync sep
H-sync level shift
phase split
osc adj
resistance is measured
VOM ranges
K ohm: R X 1,000
ohm: R X 100
Voltage respect to the ground, measured by either 10 or 2.5 V range
○16 ○15 ○14 ○13 ○12 ○11 ○10 ○9
1.7V 0.3V 5.6V 1.5V -0.05V 1.5V 2.7V■ 3V
5k 9k 5k 3.4k 3.6k 4.2k 4.2k 1.8k

Fig. 1-5
Voltage, resistance and wave-forms at IC 501

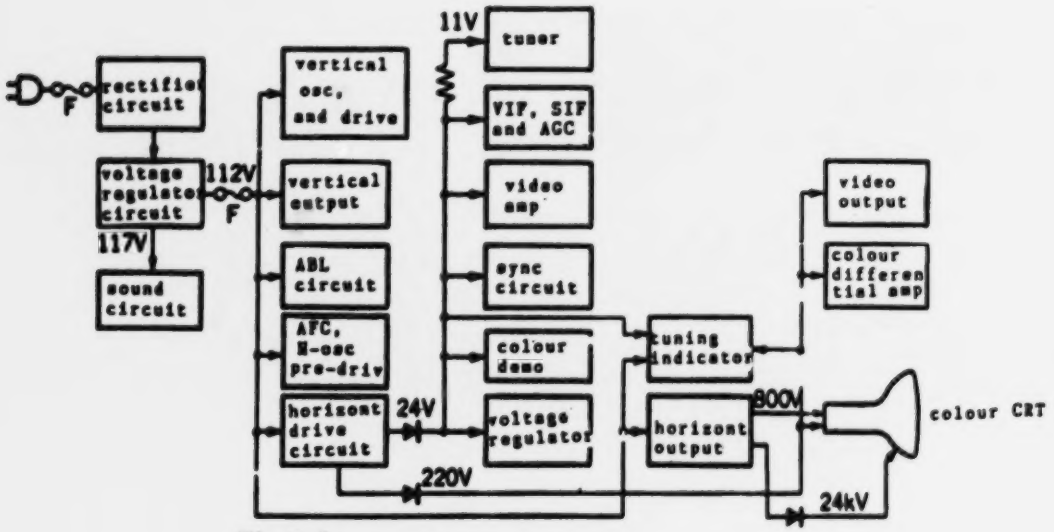


Fig. 1-6
Voltage distribution of supply voltage

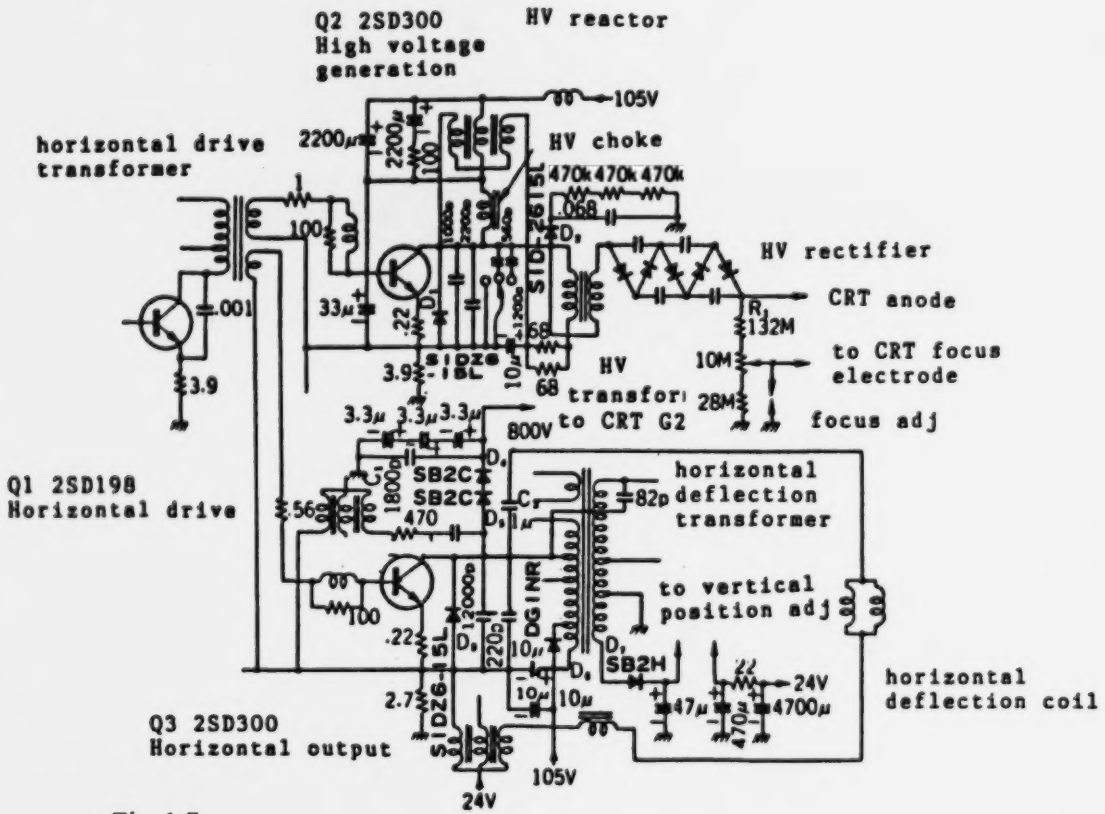


Fig. 1-7
Horizontal output and high-voltage circuit

2 No raster

This symptom is characterised by the absence of the raster on the screen. However, the sound reproduction is normal.

Cause: For solid-state receivers, this symptom is caused by a breakdown in the video amplifier, ABL (Automatic Brightness Limiting) circuit, CRT circuit or in the horizontal deflection and high-voltage circuits.

In vacuum-tube receivers, a breakdown in the horizontal deflection, high voltage or focus-rectifier circuits may cause the symptom.

TROUBLE-SHOOTING PROCEDURE

a **Solid-state receivers**

Measure or check the high voltage at the anode of the CRT. If the anode voltage is very low or zero, trouble-shoot the horizontal output circuit and the high-voltage circuit.

If the high voltage is normal, trouble-shoot the video amplifier, the automatic brightness limiter (ABL) and the second grid circuit of the CRT. Refer to Fig. 2-1 for the trouble-shooting flow chart.

1 ***High-voltage measurement***

The anode voltage of the CRT may be measured correctly with a high-voltage meter. Place the tip of the high-voltage meter probe carefully at the anode button of the CRT. Never remove the high-voltage connection to the CRT.

When measuring the high voltage with a high-voltage meter, take extra caution, since the anode voltage is very high and the cone part of the CRT where the anode button is located is physically weak. A minor mistake may prove to be very dangerous. When inserting the tip of the high-voltage meter probe under the anode cap, be careful not to scratch or, worse, crack the cone of the CRT. This may cause it to implode and then explode. In solid-state receivers, ***never*** attempt to draw an arc between a screwdriver and the anode cap. Doing so will overload the horizontal output circuit and destroy the transistors.

A quick method of checking the high voltage: Place the back of the hand or the arm near the surface of the CRT screen. If the high voltage is normal, you will feel a static charge—indicated by the rising of the hair on the hand or arm every time the receiver is switched on or off. TV repair-men should develop this habit of checking the presence of high voltage. Although this method does not give you an exact diagnosis of the high voltage, it could help you decide what to trouble-shoot first.

The high voltage can also be checked by measuring the G2 voltage of the CRT. If the voltage at node A in the G2 circuit in Fig. 2-2 is around 800 V, assume the anode voltage for this circuit to be normal.

The usual high voltage of 16" to 22" colour CRTs is around 23 kV. In black-and-white CRTs, the usual high-voltage value is around 7 kV. The maxi-

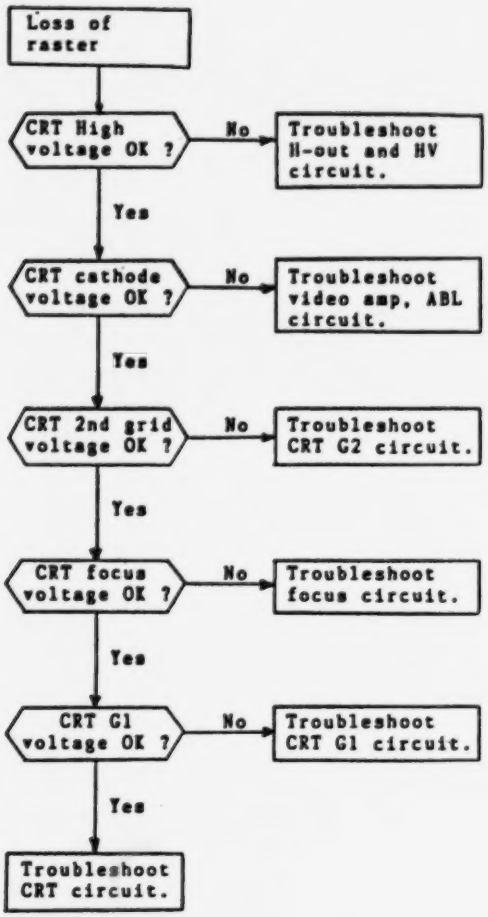


Fig. 2-1
Trouble-shooting flow chart for loss of raster, sound present

mum anode voltage of colour CRTs is limited to 25 kV; if the anode voltage exceeds this value, greater amounts of X-rays are produced and may be dangerous. X-rays are produced in colour CRTs because the electron beams that are accelerated towards the CRT screen strike the metal shadow mask. The shadow mask, being bombarded by high-velocity electrons, emits X-ray radiations.

However, in colour CRTs the acceleration voltage (anode voltage) for the electron beam is considerably lower than the accelerator voltage of commercial X-ray equipment. The X-rays emitted by colour CRTs are called "soft" X-rays; those emitted by commercial X-ray equipment are called "hard" X-rays. Thus, when the high voltage of the colour CRT is within the normal maximum value, X-rays emitted by colour TVs are not dangerous.

In colour CRTs, as long as the CRT bias circuit is normal, a dim raster can still be seen on the screen even if the anode voltage drops down to around 5-7

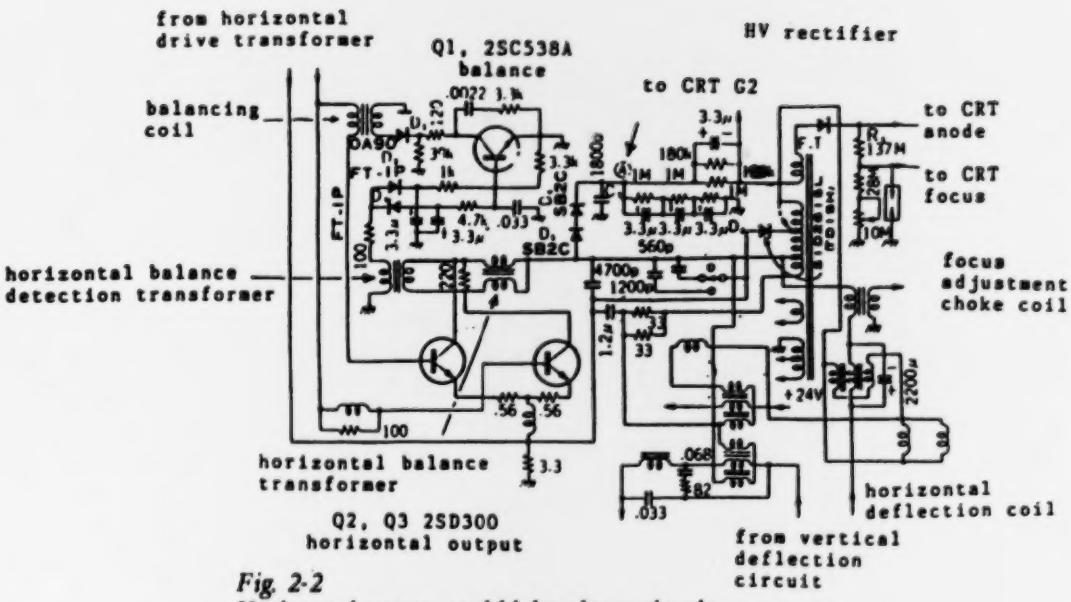


Fig. 2-2
Horizontal output and high-voltage circuit

kV. Similarly, in black-and-white CRTs, a dim raster can still be seen on the screen even if the anode voltage drops to around 2 to 3 kV. Anyway, if the anode voltage is considerably lower than the normal value, the static charge produced on the screen will not be strong enough to be felt by the hand. In this case, use a high-voltage meter if you want to measure the exact value of the anode voltage.

A drop in the high voltage is mainly caused by an overload in the high-voltage circuit. Thus, if the anode voltage is very low, check for a shorted component in the surrounding circuits of the CRT such as the high-voltage or flyback transformer.

Figs. 2-2 and 2-3 show two different types of horizontal output circuit used in solid-state colour receivers. In Fig. 2-2 the horizontal output transistor is also used as the high-voltage generator transistor. In Fig. 2-3 the horizontal output and the high-voltage generator circuits have separate transistors. Thus, when the high-voltage is lost, trouble-shoot the horizontal output and the high-voltage generator circuits in the former type, and trouble-shoot the high-voltage rectifier and the high-voltage generator circuit in the latter type.

2 ***Trouble-shooting the high-voltage rectifier and the high-voltage output circuit***

Confirm the presence of horizontal deflection pulses at the collector of one of the horizontal output transistors (Q2 or Q3) in Fig. 2-2. Use a VOM (1000 V/AC range) with a capacitor (around 0.1 uF/1000 V) connected in series to the positive probe for signal tracing. A reading of around 1000 V indicates normal operation. Apply the same procedure in trouble-shooting the horizontal output and high-voltage circuits shown in Fig. 2-3.

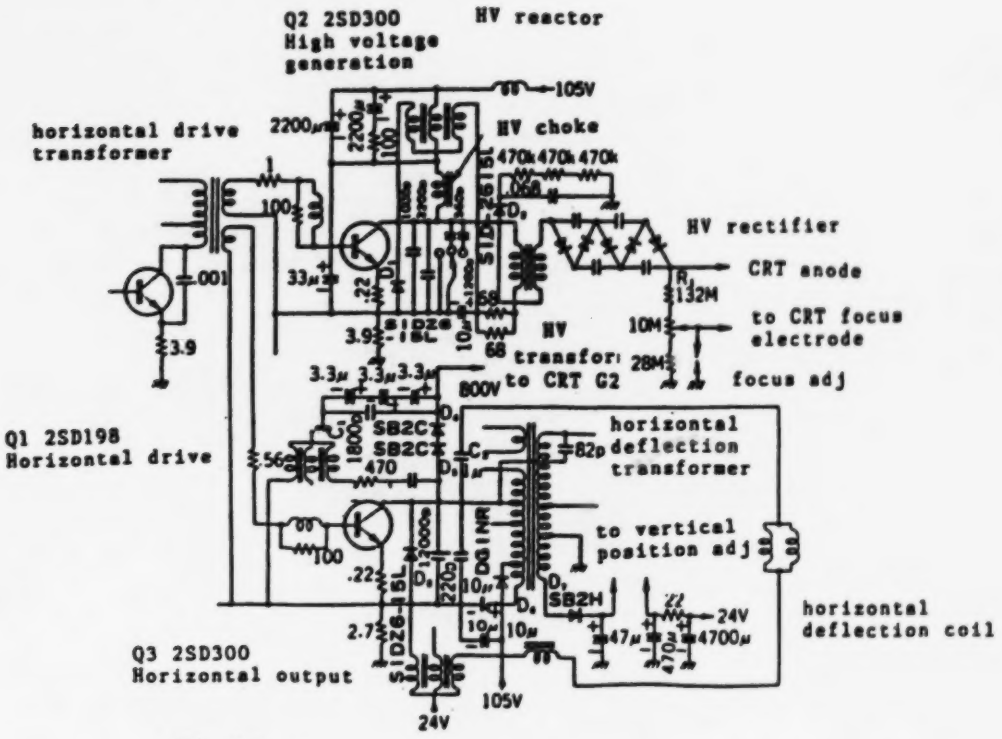


Fig. 2-3
Horizontal output and high-voltage circuit

If the reading is zero or very low, set the VOM to 10 V AC range and measure the input pulses at the base of the horizontal output transistor. If horizontal deflection pulses are present at the input, you should get a reading of around 3 V AC.

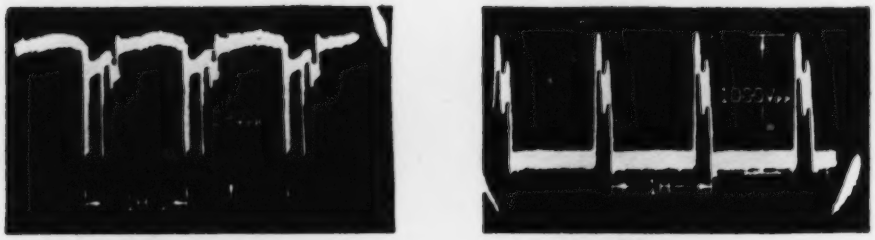
The input and the output pulses of the horizontal output transistor can be accurately measured with an oscilloscope. Refer to Picture 2-2 for the proper wave-forms of the circuit in Fig. 2-2.

If any of the voltages or wave-forms is wrong, find the defective component in the defective stage through voltage measurements and resistance readings. Give emphasis to the horizontal output transistor and the immediate components surrounding it.

If the high voltage is absent, check the high-voltage rectifier diodes and the windings of the high-voltage or horizontal output transformer (HOT).

3 *Trouble-shooting the video amplifier*

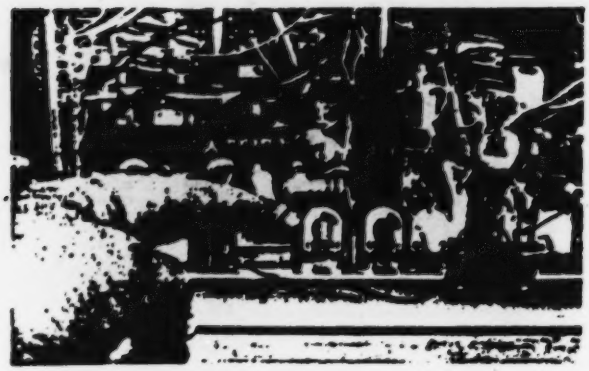
Trouble-shoot the video amplifier circuit if the high voltage is normal. A defective video amplifier (ABL inclusive) can be isolated by disabling the vertical deflection circuit or by setting the white-balance service switch to the service mode. (See Picture 2-3.) The vertical deflection circuit can be disabled by disconnecting a pin cable that supplies the supply voltage in some colour TV sets. If a thin



(a) base, horizontal output transistors (Q2, Q3)

(b) collector, horizontal output transistor (Q2, Q3)

Picture 2-2
Wave-forms at horizontal output circuit



Picture 2-3
White balance adjustment switch

horizontal line appears on the screen, the video amplifier or ABL circuit is defective.

A defective video amplifier can also be isolated by measuring the cathode voltage of the CRT. First, set the brightness control to maximum, then measure the cathode voltage of any electron gun in the colour CRT. The usual normal value is around 120 V.

The cathode voltage, however, increases up to 160 V when the brightness control is set at minimum. If the cathode voltage is much higher than the normal maximum value, the video amplifier (ABL circuit inclusive) is defective.

The video amplifier circuit drives the colour CRT, and the ABL circuit controls the brightness of the CRT. Trouble in any of these circuits may result in an excessive DC bias voltage to be supplied to the cathode of the CRT. An excessive cathode voltage may cut off the beam current and result in the loss of the raster.

The DC bias cathode voltage of the CRT can be checked by measuring the output voltage of the video output amplifier transistor. If the output voltage is normal, the DC level of the video output signal has increased. This means that

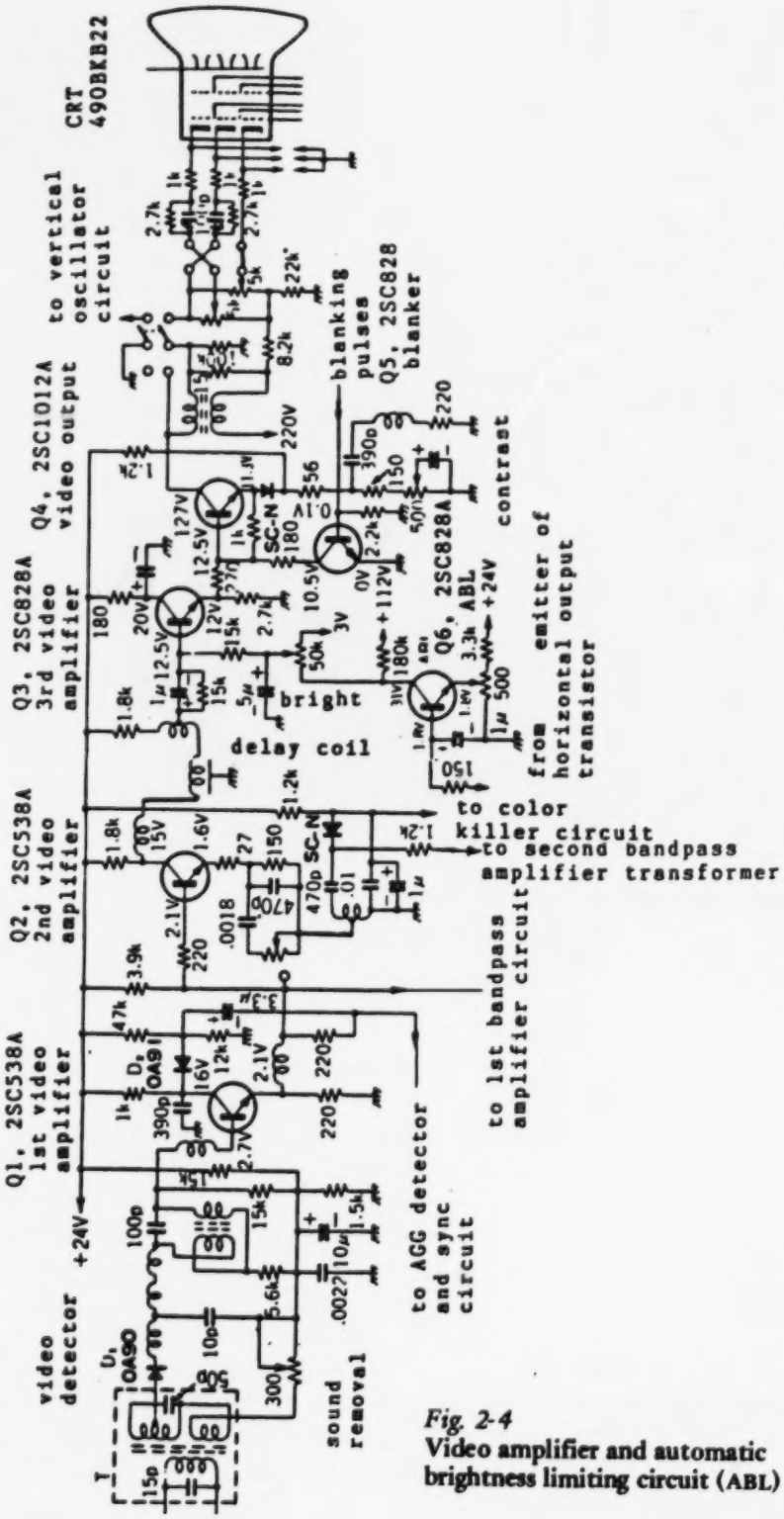


Fig. 2-4
Video amplifier and automatic brightness limiting circuit (ABL)

the video output amplifier stage is defective. The trouble, however, could be in the preceding stages. Otherwise, if the video output voltage is normal, the ABL circuit is defective.

As shown in Fig. 2-4, the stages in the video amplifier circuit are D-C, or directly coupled. Thus, a defective stage can affect the biasing of the succeeding stages and increase the D-C level of the video signal. The defective video amplifier stage can be located by measuring the transistor voltages.

4 ***Trouble-shooting the CRT circuits***

Measure the second grid no. 2 voltage of any electron gun in the colour CRT. You can do this from the CRT base circuit board, as shown in Picture 2-4. In the circuits in Figs. 2-2 and 2-3 the normal value is around 600 V. If the voltage is zero, check C1, D4 and D5.

If the second grid (G2) voltage is normal and a bi-potential colour CRT is used, measure the focus voltage with a high-voltage meter. The normal focus voltage for a bi-potential colour CRT ranges from 4 to 6 kV. If the voltage is zero or very low, check for an open resistor (R1). If the CRT is a uni-potential type, the focus voltage can vary from zero to around 400 V. Thus, the value of the focus voltage has nothing to do with the loss of the raster.

Sometimes the trouble may be a low G1 voltage, but this case is rare. Nevertheless, check the G1 circuit for a defective component.

TROUBLE-SHOOTING A VIDEO AMPLIFIER IC CIRCUIT

5 **IC receivers**

The procedures and flow chart for trouble-shooting IC receivers and solid-state receivers are similar. The procedure in trouble-shooting a video amplifier IC circuit will be discussed. Refer to the circuit in Fig. 2-5.

Measure the DC cathode voltage of the CRT. Generally, the usual normal value ranges from a minimum of 140 V (maximum brightness setting) to a

Picture 2-4
Measuring the CRT electrode voltage

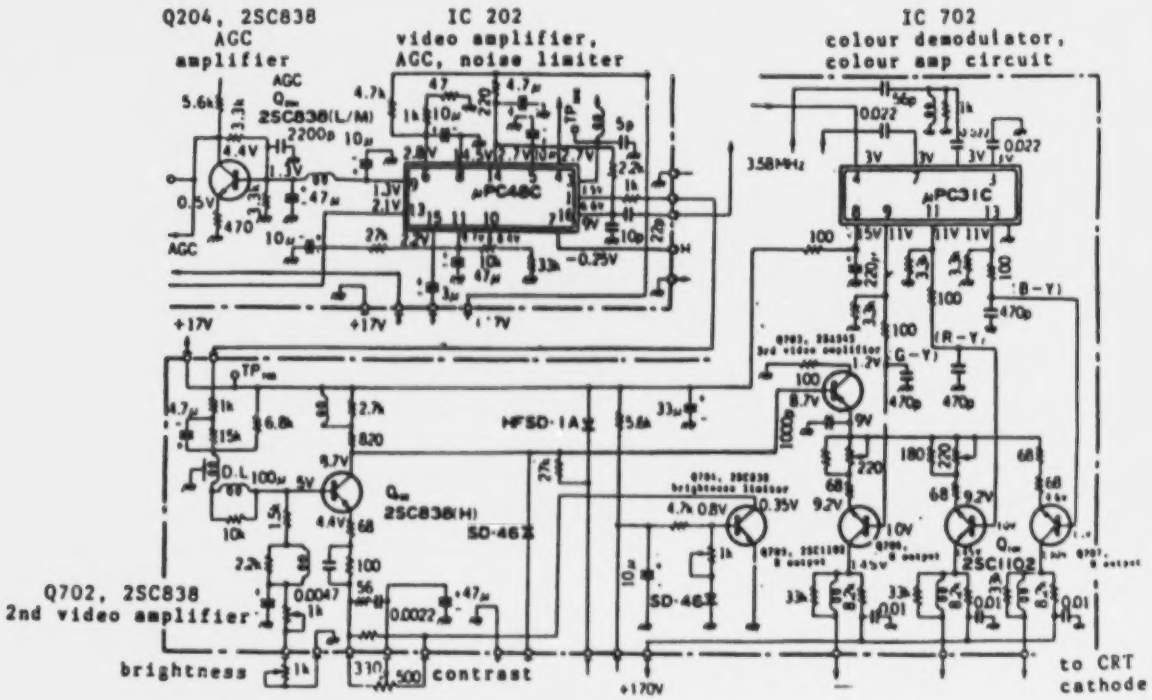


Fig. 2-5
Video amplifier, colour demodulator and output circuit

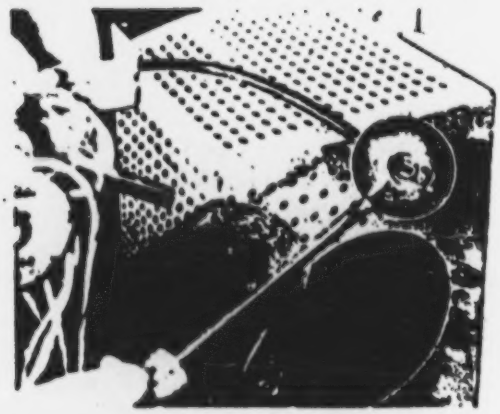
maximum of 170 V (minimum brightness setting). If the DC cathode voltage is very high, the trouble may be anywhere from the first video amplifier to the video output amplifier (brightness limiting circuit included).

To locate the defective component, you should identify the defective stage first by wave-form analysis or voltage measurements. If any of the pin wave-forms or pin voltages of IC202 (uPC48C) is incorrect, shut off the receiver and measure pin resistance relative to ground. Check also the continuity or resistances of the surrounding components of the defective stage.

c **Tube type**

First, check the high voltage of the CRT. The methods discussed earlier in checking or measuring the high voltage in solid-state receivers can also be used. However, unlike in solid-state or IC receivers, you may draw an arc between the anode cap and a well-insulated screwdriver, as shown in Picture 2-5, to check the high voltage.

Place the tip of the well-insulated screwdriver near the pin in the anode cap. The screwdriver should be held by the insulated handle. Do not touch the metal part to avoid electric shock. An arc (around 5 to 8 mm) should be drawn between the tip of a screwdriver. If the screwdriver is grounded to the chassis or circuit ground, a longer arc (around 2 cm) could be drawn. In any case, if an



Picture 2-5
Spark test

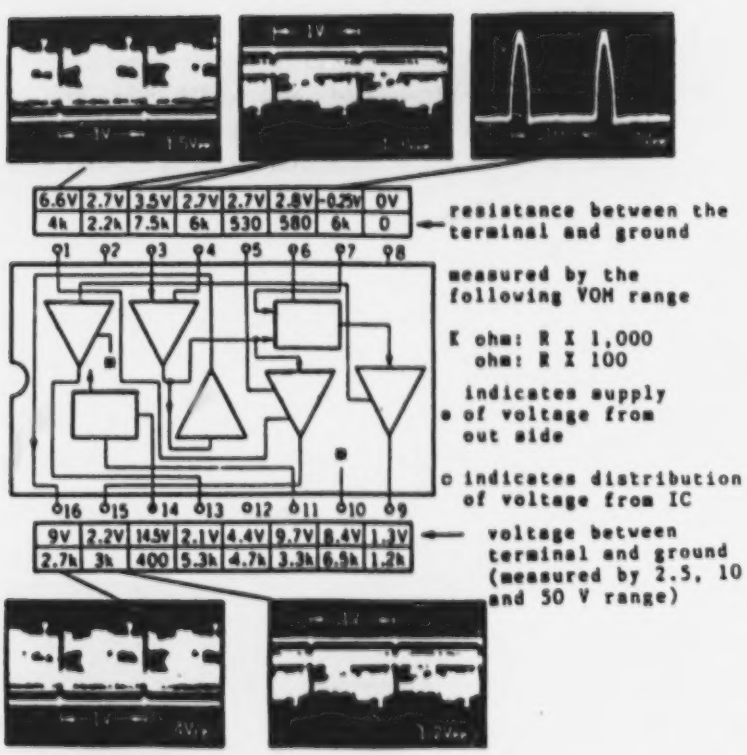

6.6V 2.7V 3.5V 2.7V 2.7V 2.8V -0.25V 0V
4k 2.2k 7.5k 6k 530 580 6k 0
resistance between the terminal and ground
1 2 3 4 5 6 7 8
measured by the following VOM range
K ohm: R X 1,000
ohm: R X 100
indicates supply of voltage from out side
indicates distribution of voltage from IC
16 15 14 13 12 11 10 9
9V 2.2V 14.5V 2.1V 4.4V 9.7V 8.4V 1.3V
2.7k 3k 400 5.3k 4.7k 3.3k 6.5k 1.2k
voltage between terminal and ground (measured by 2.5, 10 and 50 V range)

Fig. 2-6
Normal voltage, resistance and wave-forms of IC 202 (uPC48C)

arc cannot be drawn, the high-voltage supply of the anode pin is either zero or very low. Take extra caution when drawing an arc especially in colour receivers, since the anode voltage of a colour CRT is around 23 kV. Furthermore, if an arc is drawn, do not let the tip of the screwdriver touch the pin in the anode cap to avoid electric shock.

After checking or measuring the high voltage, measure the focus voltage (usually pin 9) of the CRT. The usual normal value is between 4 and 6 KV. If the focus voltage is normal, a 1 mm arc can be drawn between the focus terminal and a grounded clip cord.

If the anode voltage and the focus voltage are zero or very low, the trouble is mainly in the horizontal deflection circuit. If the focus voltage is normal but the high voltage is not, the high-voltage generator circuit is defective. If the high voltage is normal but the focus voltage is not, the focus rectifier circuit is defective. If the high voltage and the focus voltage are normal, the video amplifier may be defective or the filament of the CRT may be open. Make use of the trouble-shooting flow chart in Fig. 2-7.

1 ***Trouble-shooting the horizontal deflection circuit***

Check if the sawtooth signal is supplied to the horizontal output tube (V1) in Fig. 2-8 by measuring the AC voltage at G1. Use a VOM (50 V AC range) with a 0.1 uF capacitor connected in series with the positive probe. A reading of around 30 V AC indicates the presence of the sawtooth signal. This means that the trouble is in the horizontal deflection output circuit. But if the reading is zero or very low, the trouble is in the horizontal oscillator circuit.

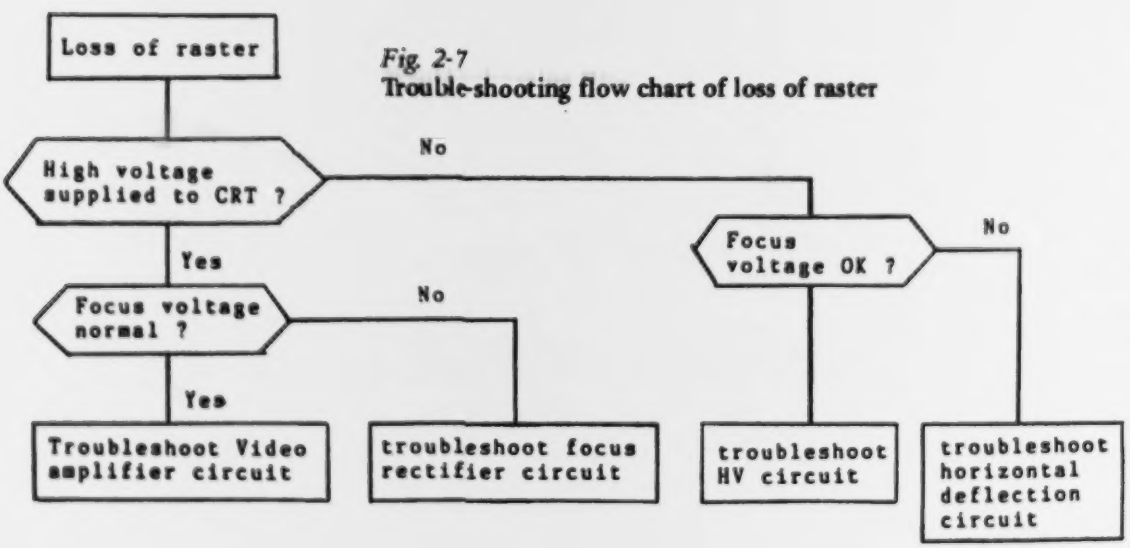


Fig. 2-7
Trouble-shooting flow chart of loss of raster

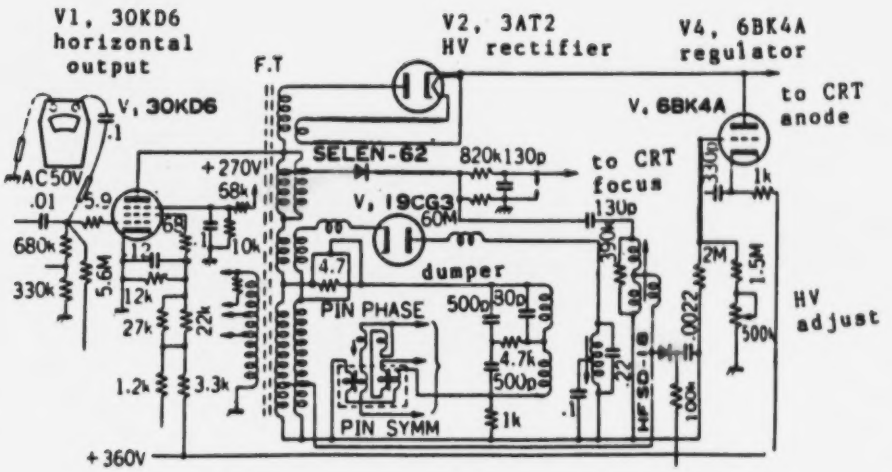


Fig. 2-8
Horizontal output and high-voltage circuit

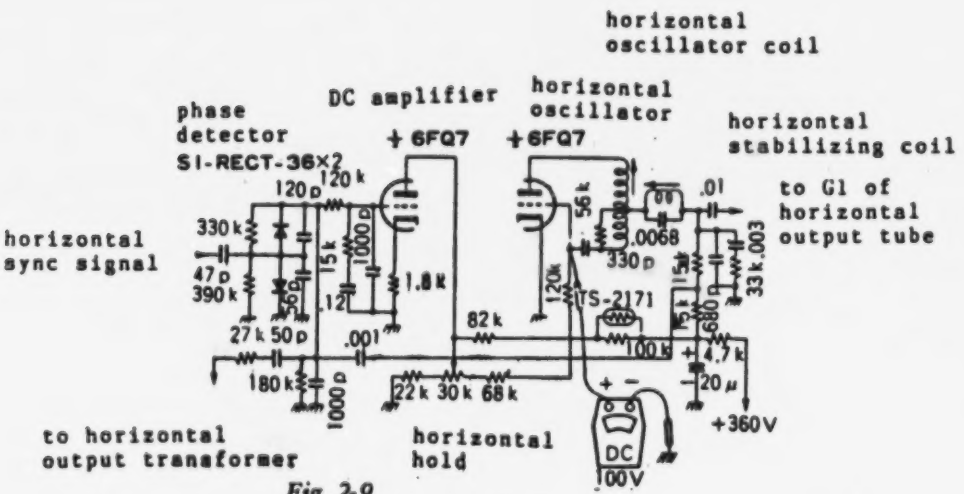


Fig. 2-9
Horizontal AFC circuit

2 ***Trouble-shooting the horizontal oscillator***

Check if the oscillator tube in Fig. 2-9 is oscillating by measuring the DC G1 voltage with a VOM set at the proper DC range. For a blocking oscillator, the usual normal value is -60 V DC; that for a multivibrator oscillator is around -10 V DC.

3 ***Trouble-shooting the video amplifier circuit***

An example of a video amplifier circuit is shown in Fig. 2-9. First, check the tubes, since defective tubes are very common troubles. Replace them with good ones if possible. If the tubes are operating properly, proceed by measuring the DC cathode voltage of the colour CRT. For the given circuit, the normal value

ranges from 200 V (maximum brightness) to 300 V (minimum brightness). If the DC cathode voltage is very high, locate the defective component in the video amplifier circuit. Common defective components causing the symptom are indicated with arrows in Fig. 2-9.

4 ***Trouble-shooting the HV and the focus rectifier circuits***

Before trouble-shooting this circuit, discharge the stored high voltage in the CRT anode. This can be done by grounding the anode pin with a thick and well-insulated clip cord. Always exercise extreme caution when trouble-shooting these circuits to avoid electric shock.

Check the high-voltage rectifier tube or replace it with a good one. If this tube is in good condition, check the components indicated with arrows in Fig. 2-8.

3 No vertical deflection

This symptom, sometimes called the tube-light effect, is characterised by a bright thin horizontal line across the middle of the screen.

Cause: This symptom is caused by a breakdown in the vertical deflection circuit. Hence, the trouble may be in the vertical oscillator, amplifier or output circuits.

TROUBLE-SHOOTING PROCEDURE

First, set the brightness to minimum. When the vertical deflection is lost, the beam current is concentrated in a single horizontal line across the screen. If the brightness is not reduced, the phosphor screen may get burnt. After doing so, start trouble-shooting. Refer to the flow chart shown in Fig. 3-1 for the isolation of the breakdown circuit.

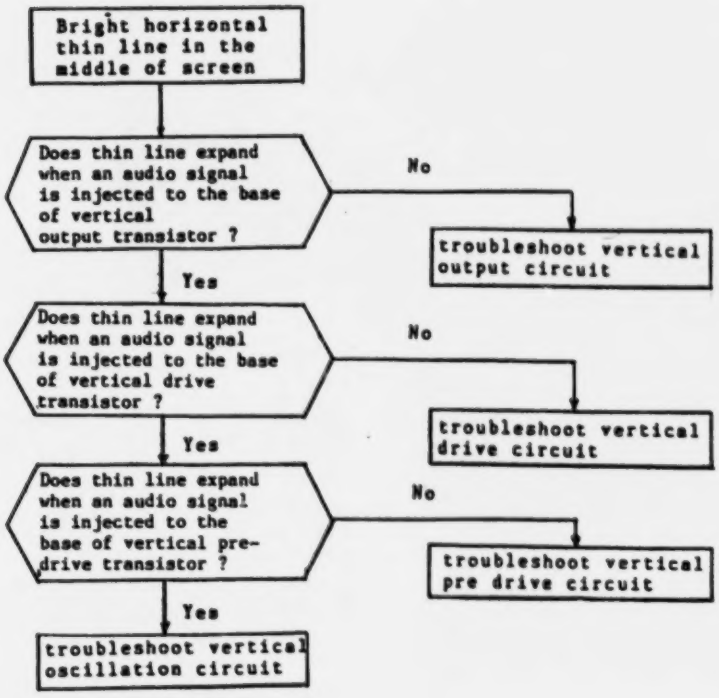

Bright horizontal thin line in the middle of screen
Does thin line expand when an audio signal is injected to the base of vertical output transistor ?
No
troubleshoot vertical output circuit
Yes
Does thin line expand when an audio signal is injected to the base of vertical drive transistor ?
No
troubleshoot vertical drive circuit
Yes
Does thin line expand when an audio signal is injected to the base of vertical pre-drive transistor ?
No
troubleshoot vertical pre drive circuit
Yes
troubleshoot vertical oscillation circuit

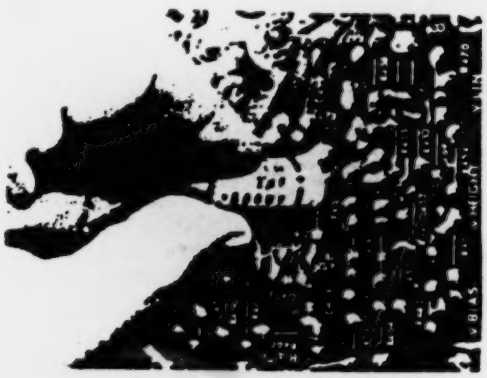
Fig. 3-1
Trouble-shooting flow chart for no vertical deflection

a Solid-state receivers

Start by isolating the defective stage in the vertical deflection circuit. Refer to Fig. 3-3 for an example of a vertical deflection circuit. Inject an audio signal at the base of the vertical output transistor (Q4) through an electrolytic capacitor (around 1-2 uF), as shown in Picture 3-1. If the line on the screen does not expand, the output circuit is defective. Otherwise, if the line expands, as in Picture 3-2, the output circuit is normal. The degree to which the line expands depends on the strength of the injected audio signal. Proceed then to inject the audio signal at the base of the vertical drive transistor (Q3) if the output circuit is normal.

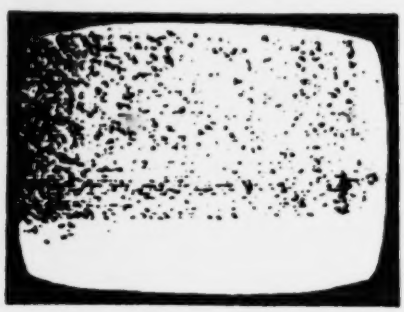
If the line does not expand, the vertical drive stage is defective. But if the line expands, as shown in Picture 3-3, the stage is normal. Proceed then to inject the signal at the base of the vertical pre-drive transistor Q2. If the line expands, the vertical oscillator circuit is defective. Otherwise, the vertical pre-drive stage is defective.

It would be faster to locate the defective stage by using an oscilloscope. For the circuit in Fig. 3-3, start from the base to the emitter of the oscillator



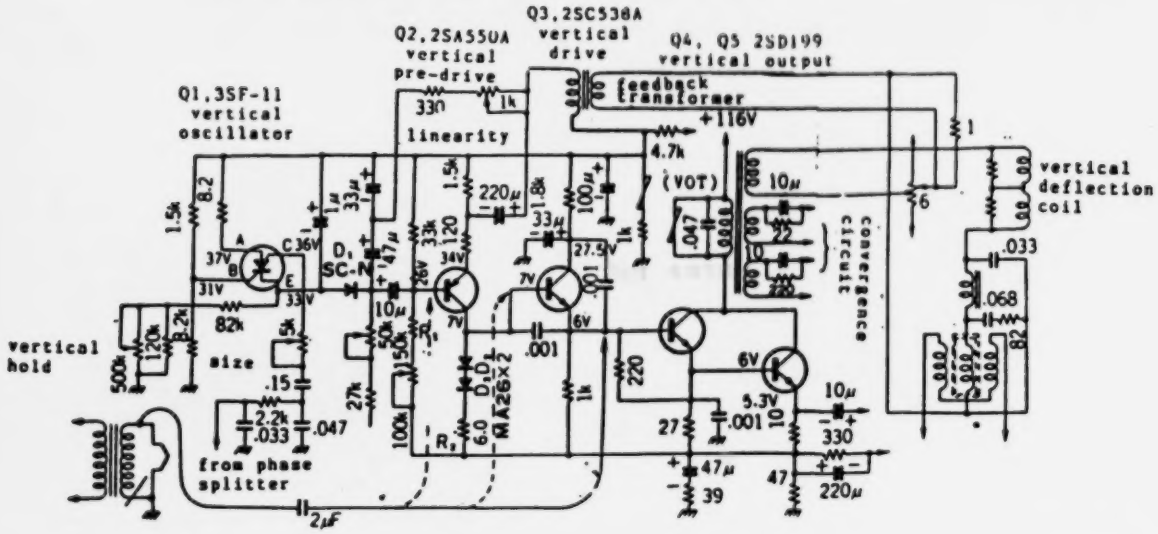
Picture 3-1
Injection of AF signal

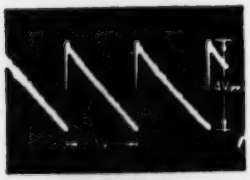
Picture 3-2
When AF signal is supplied to the base of vertical output transistor.



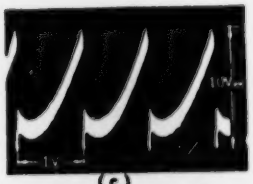
Picture 3-3
When AF signal is supplied to the base of vertical drive transistor.

transistor (Q1). Picture 3-4 shows examples of normal wave-form. If the wave-form is not correct, the oscillator stage is defective. Otherwise, if the oscillator stage is normal, observe the base signal of the pre-drive transistor (Q2). If the proper signal is absent, the circuit between Q2 and Q1 is defective. If the base signal of Q2 is normal, check its collector wave-form. If the wave-form is incorrect, the pre-drive stage is defective. Otherwise, check the emitter wave-form of the drive transistor (Q3). If the wave-form is incorrect, the drive stage is defective; otherwise, check the emitter wave-form and the collector wave-form of



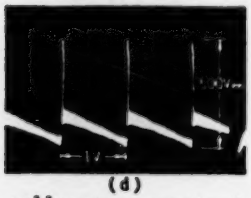


(a)
Emitter, vertical
oscillator SCS (Q1)



(c)
collector, vertical
drive (Q3).

(b)
Base, vertical
amplifier (Q2).



(d)
collector, vertical
output (Q4, Q5).

Picture 3-4

the output transistors Q4 and Q6, respectively. If any of them is incorrect, then the output stage is defective. Otherwise, if the wave-forms are correct, check the connections to the vertical deflection coil.

There are three types of oscillator circuits commonly used as the vertical oscillator. They are the SCS (Silicon-Controlled Switch), the blocking oscillator and the multivibrator. Figs. 3-3, 3-4 and 3-5 show these circuits.

On the other hand, three types of vertical output circuits are commonly used. They are class A amplifier with VOT (Vertical Output Transformer), SEPP (Single-Ended Push-Pull) and SRPP (Shunt-Regulated Push-Pull) in class B configuration. The OTL (Output Transformerless) circuit is commonly used in the SEPP and SRPP circuits.

If a multivibrator circuit is used for the vertical oscillator circuit, and if positive feedback signal is coupled from vertical output circuit to the vertical oscillator circuit, a breakdown in vertical drive and output circuit may cause

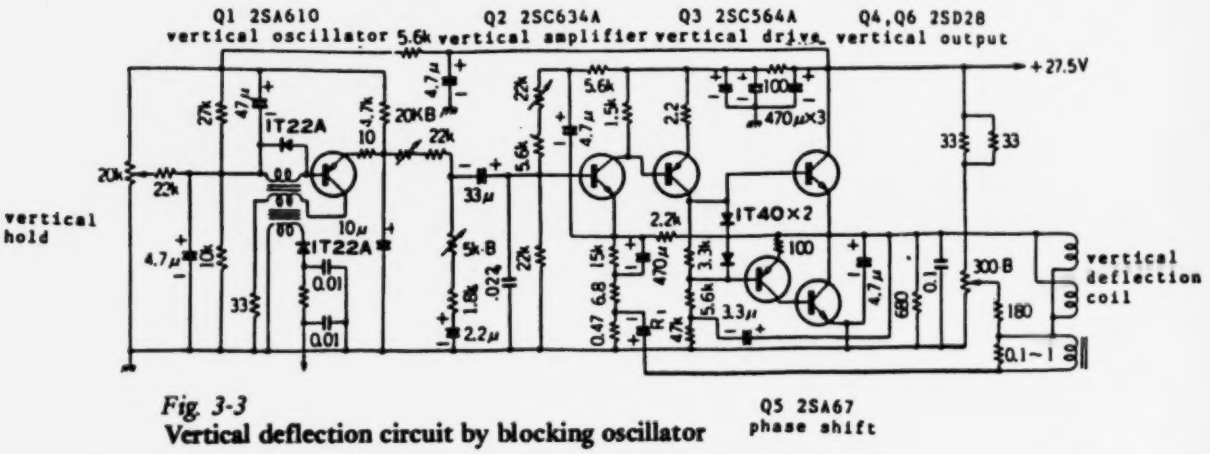


Fig. 3-3
Vertical deflection circuit by blocking oscillator

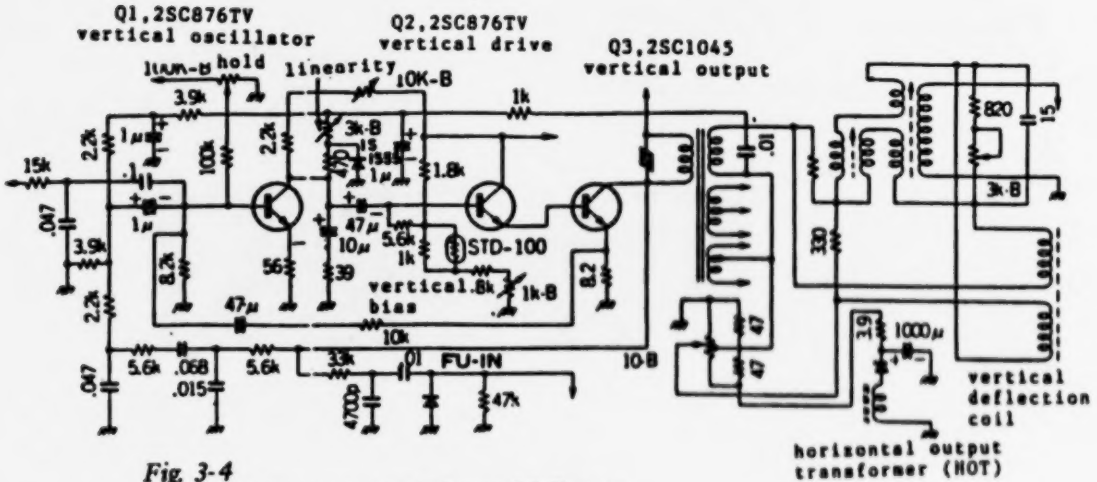


Fig. 3-4
Vertical deflection circuit by multivibrator

the oscillation to stop and result in the loss of vertical deflection. The breakdown in feedback line can easily be detected by observing the thin horizontal line on the screen. If the thin line expands a bit when the defective receiver is tuned in to the TV broadcast signal, the feedback circuit is defective. Otherwise, the feedback circuit is normal. Identify the defective stage through signal injection.

It is easier to identify the defective stage by signal injection if a blocking oscillator is used as a vertical oscillator. The oscillation of a blocking oscillator circuit can also be confirmed by the reverse bias voltage generated at the base of the vertical oscillator transistor. Use DC-V mode to measure the voltage.

Technical memo

In case of a complementary push-pull vertical output circuit, if one of the transistor's collector and emitter junctions becomes shorted, it may cause horizontal thin lines. But in modern TV receivers, the transistor used for vertical output is tough and the other vertical output transistor won't break down together. Therefore, if the proper bias is given to this transistor, the vertical output circuit works but insufficiently and shows the symptom of insufficient vertical deflection described in Symptom (5).

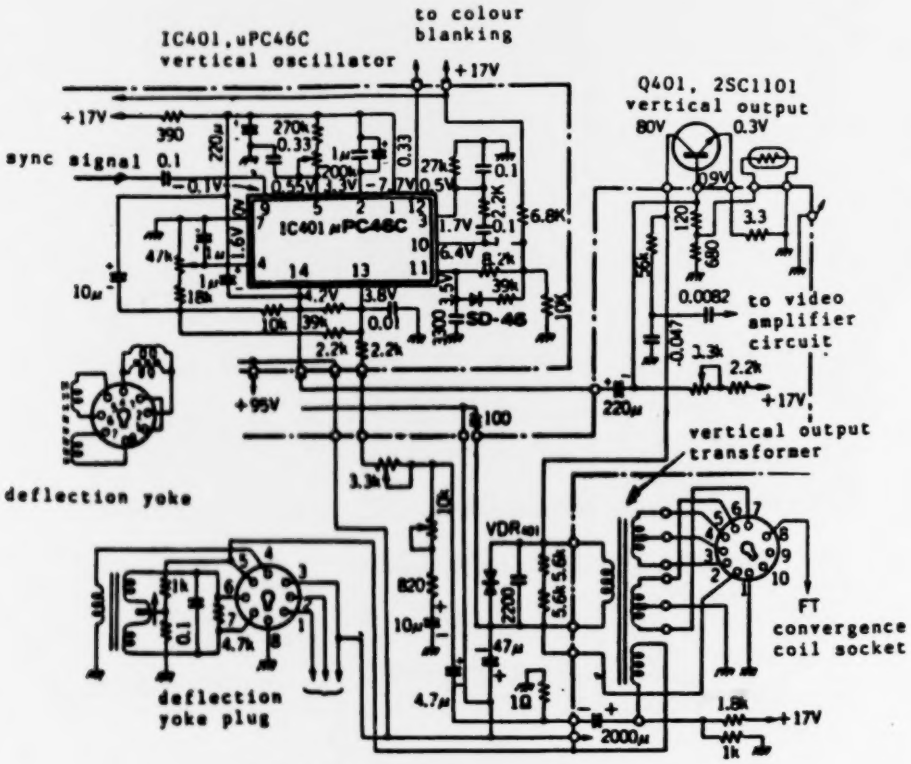


Fig. 3-5
IC vertical deflection circuit

b IC receivers

In this section, references will be made to the circuit in Fig. 3-6. The most logical procedure in locating the defective stage is to observe the wave-forms starting from the vertical oscillator circuit (IC401) towards the vertical output circuit. After locating the defective stage, pinpoint the defective component with the aid of a VOM.

1 ***Trouble-shooting IC401***

Fig. 3-6 shows the internal block diagram of IC401 (uPC46C). The vertical oscillator and amplifier circuits are included in the IC chip. The output wave-form can be observed at pins no. 5 and 14. When a wave-form is incorrect, measure

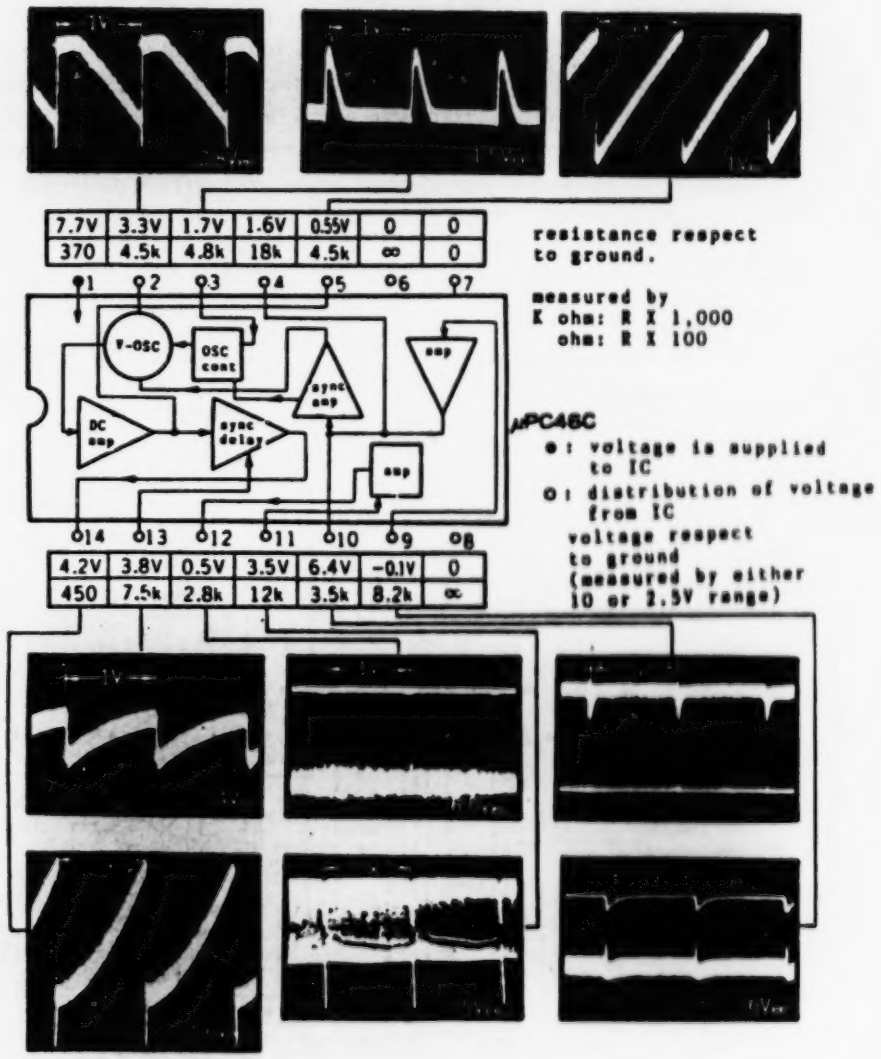

7.7V 3.3V 1.7V 1.6V 0.55V 0 0
370 4.5k 4.8k 18k 4.5k ∞ 0
resistance respect to ground.
measured by
K ohm: R X 1,000
ohm: R X 100
1 2 3 4 5 6 7
V-OSC
OSC cont
sep
sync sep
DC sep
sync delay
sep
μPC46C
● : voltage is supplied to IC
○ : distribution of voltage from IC
voltage respect to ground (measured by either 10 or 2.5V range)
14 13 12 11 10 9 8
4.2V 3.8V 0.5V 3.5V 6.4V -0.1V 0
450 7.5k 2.8k 12k 3.5k 8.2k ∞

Fig. 3-6
Normal voltage, resistance and wave-forms in IC 401 (uPC46C)

pin voltages and pin resistance relative to ground. The correct wave-forms, voltage and resistance are given in Fig. 3-6. If the surrounding circuit components are not defective, then replace the IC.

2 ***Trouble-shooting the vertical output circuit***

If a normal wave-form is observed at pin no. 14 at IC401, observe the wave-form at the base and collector of the vertical output transistor (Q401) in Fig. 3-5. If any observed wave-form is incorrect, use a VOM to locate the defective component. The normal voltages are also given in Fig. 3-6.

Note: The condition of the vertical output circuit can also be determined by measuring the AC signal at the base and at the collector of the vertical output transistor (Q401). A capacitor (around 0.1 uf) should be connected in series with the positive probe of the VOM.

If the circuit is operating properly, around 0.1 V AC can be measured at the base and around 40 V can be measured at the collector. These values vary with the VOM and the AC range used.

c **Tube type**

1 ***Trouble-shooting a vertical blocking oscillator circuit***

First, identify the defective stage by injecting an audio signal into the control grid of the vertical output tube in Fig. 3-7. If the thin line on the screen expands, the vertical output circuit is normal. Hence, the trouble is in the vertical oscillator circuit.

2 ***Trouble-shooting a vertical multivibrator oscillator circuit***

First, check the condition of the feedback circuit as shown in Fig. 3-8. If the feedback line is O.K., proceed with the signal injection procedure to identify the defective stage.

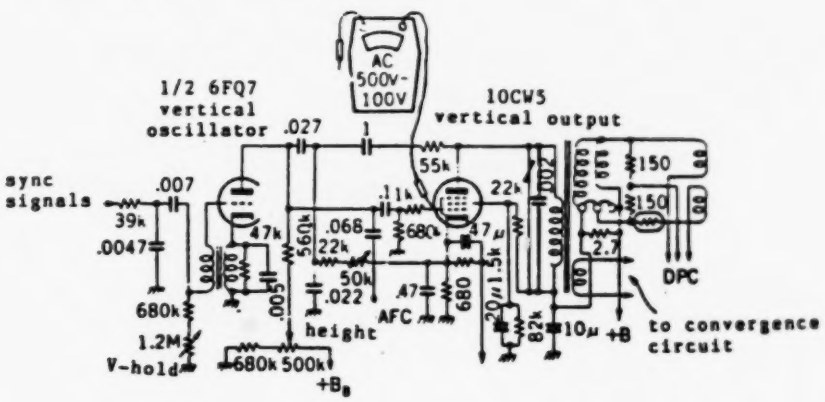


Fig. 3-7
Tube-type vertical deflection circuit with multivibrator

Hints. The signal injection method can also be used in trouble-shooting the feedback line. Inject a signal into the points shown in Fig. 3-8. If the line expands when the signal is injected at point A , then R1 and C1 are okay. If the line expands when the signal is injected at point B , then C2 is also okay. C3 can also be checked by injecting the signal between C3 and R2.

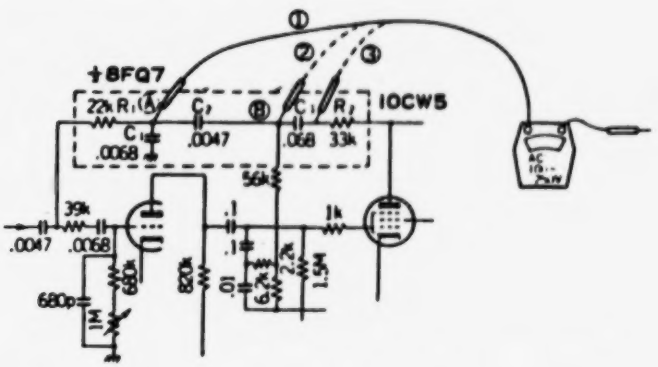


Fig. 3-8
Trouble-shooting feedback circuit

4 No vertical synchronisation

This symptom is characterised by the continuous or intermittent upward or downward rolling of the picture on the screen. The symptom cannot be eliminated by adjusting the vertical hold control.

Cause: This symptom is caused by a trouble in the integrated circuit or in the vertical oscillator circuit.

TROUBLE-SHOOTING PROCEDURE

a Solid-state circuits

This symptom has two variations. One is the intermittent rolling of the picture. This is also referred to as the "loose vertical hold." The other variation is the continuous upward or downward rolling of the picture.

In the first variation, the rolling of the picture can be momentarily stopped by adjusting the vertical hold control. However, after a short period, the picture rolls again. In this case, the vertical sync pulses are not supplied to the vertical oscillator circuit.

In the second variation, the rolling cannot be stopped, even momentarily, by the vertical hold control. In this case, the vertical oscillator circuit is defective.

Thus, for an efficient trouble-shooting, it is important to determine if the vertical hold control has any effect on the symptom. If the rolling of the picture can be momentarily stopped, or if the rolling speed and direction can be varied, the trouble is in the integrator circuit. Otherwise, if the rolling is not affected in any way by the vertical hold control, the vertical oscillator circuit is defective. Refer to the trouble-shooting flow chart in Fig. 4-1.

1 ***Trouble-shooting the integrator circuit***

An integrator circuit is shown in Fig. 4-2. It is better to trouble-shoot an integrator circuit with a VOM than an oscilloscope. If the resistors (R3, R4) or

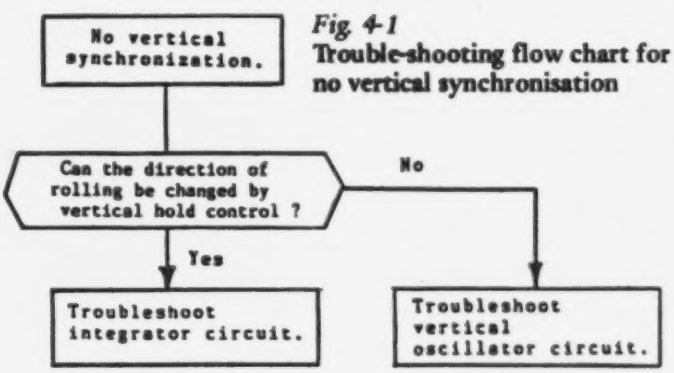

No vertical synchronization.
Can the direction of rolling be changed by vertical hold control ?
No
Yes
Troubleshoot integrator circuit.
Troubleshoot vertical oscillator circuit.

Fig. 4-1
Trouble-shooting flow chart for no vertical synchronisation

the capacitors (C2, C3) are in good condition, around 20 V can be measured at nodes 1 and 2.

2 *Trouble-shooting the vertical oscillator circuit*

If the picture rolls upwards (oscillation frequency is lower than the frequency of the vertical sync signal), check the bias circuit of the vertical oscillation transistor.

On the other hand, if the picture rolls downwards (oscillation frequency is higher than the frequency of the vertical sync signal), check the capacitor (C1 in Fig. 4-2) of the oscillator circuit.

A VOM can easily detect an open resistor but not an open capacitor. Therefore, if a capacitor is suspected to be open, shunt it with a good one.

Technical memo

The oscillation frequency of the SCS (Silicon-Controlled Switch) oscillator circuit in Fig. 4-2 depends on the time constant R X C1 and on the B+ voltage. This is true of the blocking oscillator circuit (Fig. 4-3) and the multivibrator oscillator circuit (Fig. 4-4).

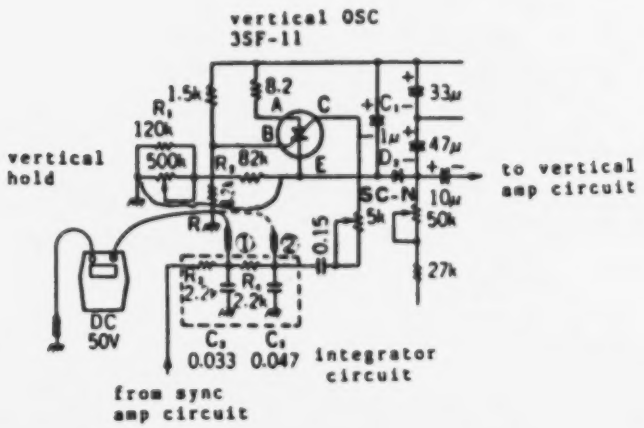


Fig. 4-2
Trouble-shooting the integrator circuit

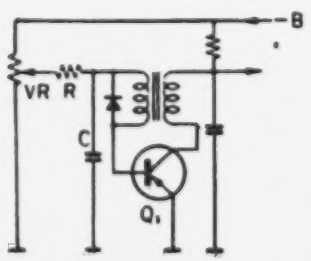


Fig. 4-3
Blocking oscillator circuit

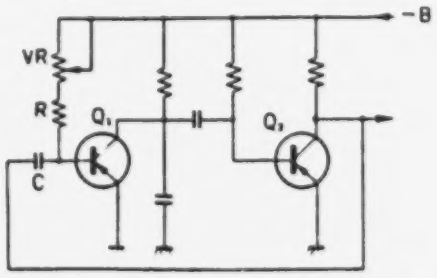


Fig. 4-4
Multivibrator circuit

b IC circuits

Fig. 4-5 shows an IC vertical oscillator circuit. This circuit will be used for reference in the following discussions.

Fig. 4-6 shows the internal structure of IC401. The sync amplifier and the vertical oscillator circuits are included in the IC. The sync signal fed to pin no. 9 is amplified by the sync amplifier circuit and then supplied to the vertical oscillator circuit. The sync signal is used to trigger the frequency of the vertical oscillator circuit.

The correct pin wave-form, voltage and resistance of the IC relative to ground are given in Fig. 4-6.

If a breakdown in the sync amplifier circuit in the IC is suspected, observe the wave-form at pin no. 9. If the wave-form is incorrect, measure the resistance of pin no. 10 relative to ground.

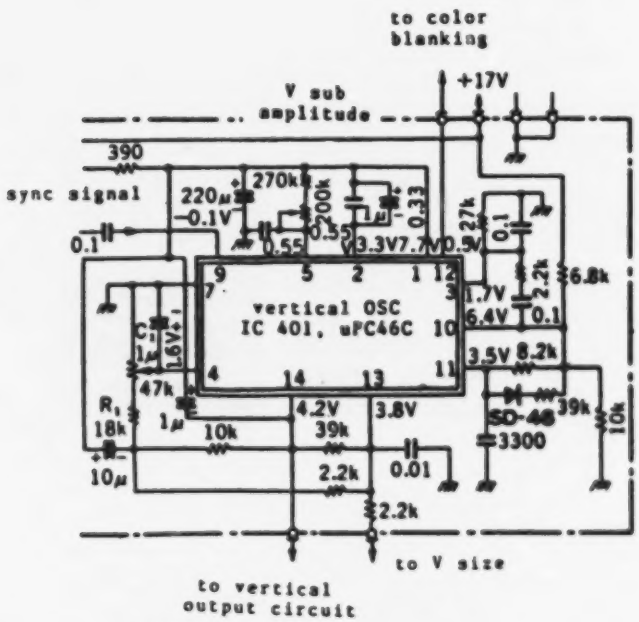


Fig. 4-5
IC vertical oscillator circuit

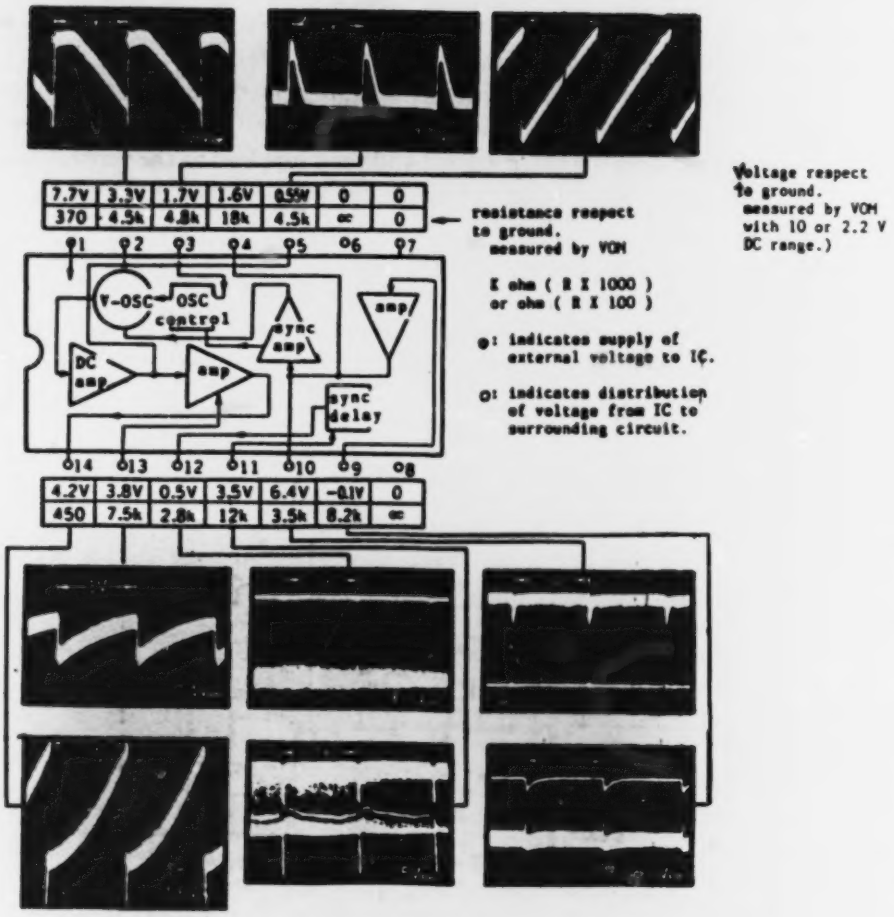

7.7V 3.3V 1.7V 1.6V 0.55V 0 0
370 4.5k 4.8k 18k 4.5k ∞ 0
resistance respect to ground. measured by VOM
Voltage respect to ground. measured by VOM with 10 or 2.2 V DC range.)
K ohm (R X 1000) or ohm (R X 100)
●: indicates supply of external voltage to IC.
○: indicates distribution of voltage from IC to surrounding circuit.
V-OSC
OSC control
sync amp
amp
DC amp
amp
sync delay
1 2 3 4 5 6 7
14 13 12 11 10 9 8
4.2V 3.8V 0.5V 3.5V 6.4V -0.1V 0
450 7.5k 2.8k 12k 3.5k 8.2k ∞

Fig. 4-6
Normal voltage, resistance and wave-forms at IC 401

5 Insufficient vertical deflection and poor linearity

Insufficient vertical deflection is characterised by a raster with insufficient height as indicated by black horizontal belts at the top and bottom of the screen. Poor vertical linearity is characterised by an image that is compressed or stretched at the top or bottom of the raster. This is very noticeable if a circle is reproduced on the screen. The circle appears to be egg-shaped.

Cause: Insufficient raster height is caused by a vertical deflection current with insufficient amplitude. Poor vertical linearity is caused by a vertical deflection current with poor linearity.

Insufficient amplitude is caused by a defective sawtooth wave generator circuit. Poor linearity is caused by a vertical drive or output circuit with a defective bias or negative feedback circuit. However, if these circuits become defective at the same time, the result is insufficient raster height and poor vertical linearity.

TROUBLE-SHOOTING PROCEDURE

For faster and easier trouble-shooting, adjust the user and service controls in identifying the defective stage.

1 ***For insufficient raster height and poor vertical linearity***

In circuits similar to Fig. 5-1, adjust the vertical height control, then the vertical linearity control alternately to get the best result.

The vertical height control mainly compensates for the bottom portion of the raster; the vertical linearity control, the linearity of the upper portion of the raster.

If the height of the raster cannot be corrected by adjusting the vertical height and linearity controls alternately, measure the DC current through the primary of the vertical output transformer (VOT). To be able to do so, make a break in the circuit at point A , then connect a VOM in series as indicated in the figure. Around 100 mA DC can be measured if the circuit is operating properly. If necessary, adjust the bias control to set the current to around 100 mA. If the current cannot be set to around 100 mA by adjusting the bias control, check the components indicated with arrows in Fig. 5-1.

Besides a defective vertical deflection circuit, a decrease in the capacitance of the ripple filter capacitor in the power-supply circuit and of the output coupling capacitor connected in series with the vertical deflection coil will cause the symptom of insufficient height.

A low B+ supply voltage results in a reduced raster size (decreased raster width and height).

2 ***For raster compressed at the top or bottom***

Adjust the vertical height and the linearity controls alternately. If the symptom

cannot be eliminated, the trouble is usually a defective sawtooth generator capacitor. The relationship between distortions in the sawtooth wave and the linearity of the raster is shown in Fig. 5-2.

In the circuit in Fig. 5-7, the sawtooth wave generator capacitor is C3. If this capacitor is leaky, the bottom of the raster becomes compressed. If it is open, the raster becomes extremely stretched at the top and extremely compressed at the bottom. The same thing happens when C3 in Fig. 5-5 becomes leaky or shorted.

In the circuit shown in Fig. 5-1, measure and adjust, if necessary, the DC current through the primary of the VOT. If the current cannot be adjusted to around 100 mA, check the components indicated with arrows in the figure.

3 ***For raster stretched at the top or bottom***

Adjust the vertical height and the linearity controls alternately to get the best result. If you cannot get proper linearity, check for an open emitter resistor in the vertical output transistor stage. Measure the DC current through the primary of the VOT if the above resistor is in good condition and adjust the bias control to set the current to the average value if necessary.

Technical memo

1 Always refer to the service manual for the correct average drive current of the VOT. The primary winding of the VOT is connected to the collector of the

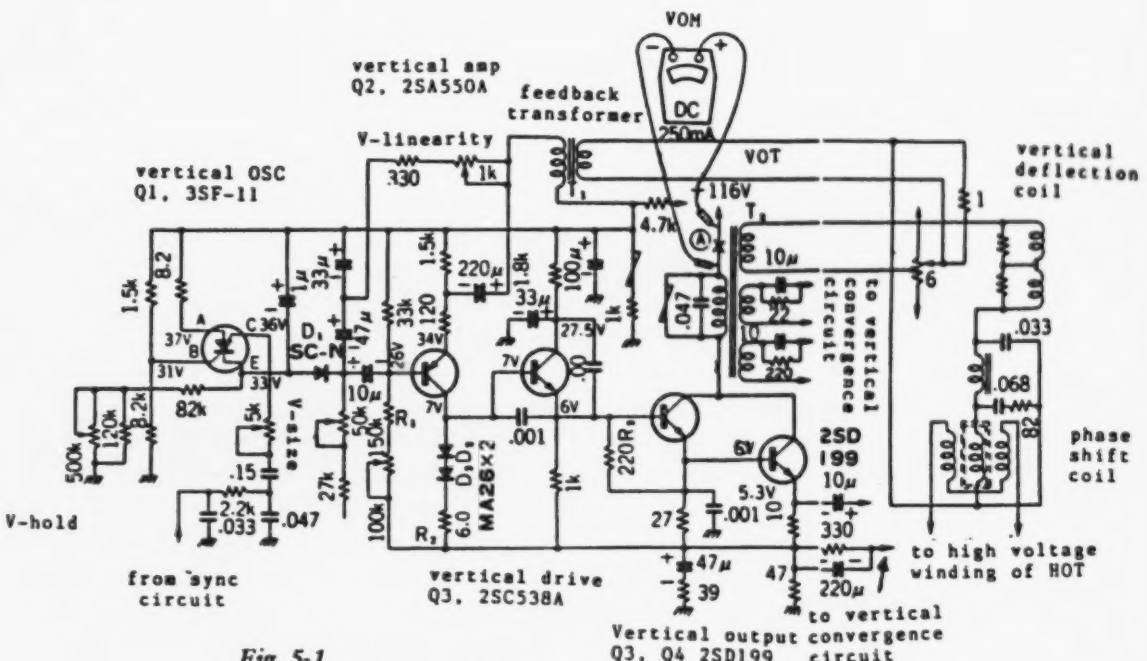
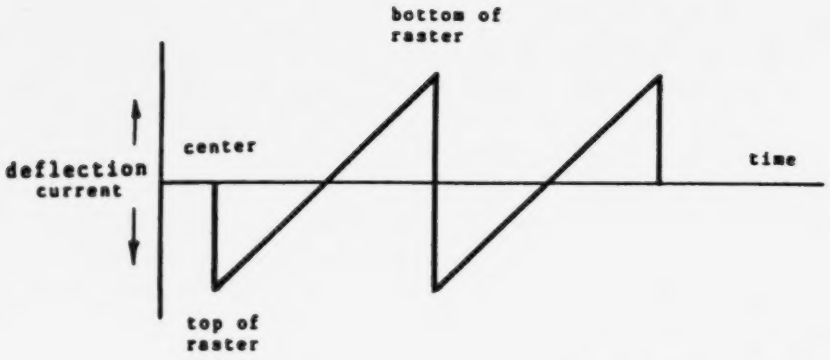
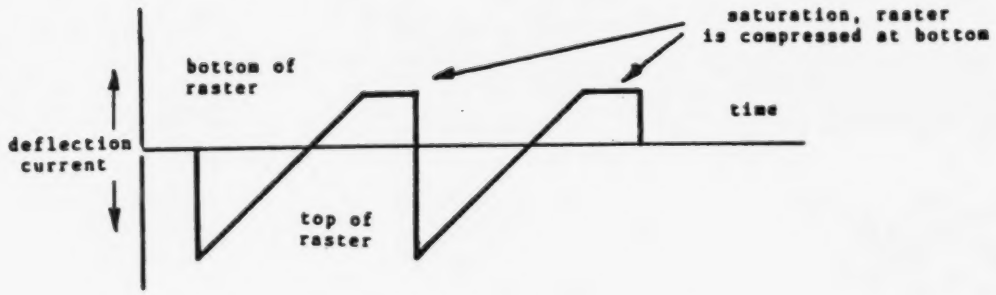


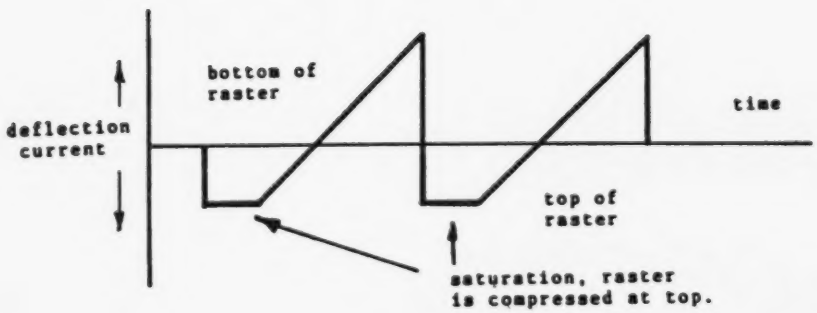
Fig. 5-1
Vertical deflection circuit



(a) Normal raster.



(b) When bottom of raster is compressed.



(c) When top of raster is compressed.

Fig. 5-2
Relationship between sawtooth wave in vertical deflection circuit and raster

vertical output transistor and it will be damaged if excessive collector current flows through it.

2 Trouble-shooting the vertical deflection circuit due to poor vertical linearity is harder than trouble-shooting the circuit due to a loss in vertical deflection. When vertical deflection is lost, the wave-forms and voltages of the circuit are very different from the correct ones. However, if the trouble is only poor linearity, the wave-forms and voltages are close to normal or may seem correct, since the vertical deflection circuit is more or less operating although not properly. Thus, during trouble-shooting, it is important to get accurate voltage and wave-form readings for comparison with the correct voltages and wave-forms given in the diagram.

3 If the image has poor vertical linearity, the defective components are usually traced to the vertical amplifier and output circuits. It is more convenient and faster to trouble-shoot with an oscilloscope. Common troubles are defective transistors and resistors. A shorted feedback transformer (T1) in Fig. 5-1 or a shorted VOT is also a possible trouble, but this is rare.

Detecting a partial short circuit within the VOT with a VOM is difficult. First, check all the possible defective components and if they are all confirmed to be in good condition, then replace the VOT.

4 A trouble symptom similar to poor vertical linearity is vertical fold-over. For circuits similar to Fig. 5-1, fold-over will appear at the top of the raster if R1 in the base circuit of Q2 becomes open. Defective diodes (D2, D3) and open R2 in the collector circuit will cause fold-over at the bottom of the raster.

5 Another example of a vertical deflection circuit is shown in Fig. 5-3. The trouble-shooting procedure for this circuit and the circuit in Fig. 5-1 is similar. The most likely defective components are indicated with arrows in the diagram.

6 In SEPP (Single-Ended Push-Pull) vertical deflection circuits using a multivibrator shown in Fig. 5-4, the vertical output transistor Tr4 conducts during the first half of the vertical trace period while Tr5 conducts during the last half.

When the emitter resistor of Tr4 becomes open, the vertical output circuit

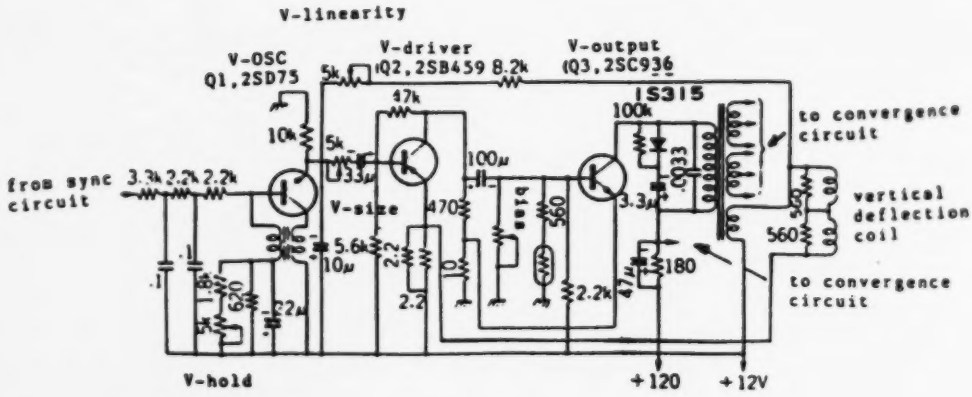


Fig. 5-3
Vertical deflection circuit by blocking oscillator

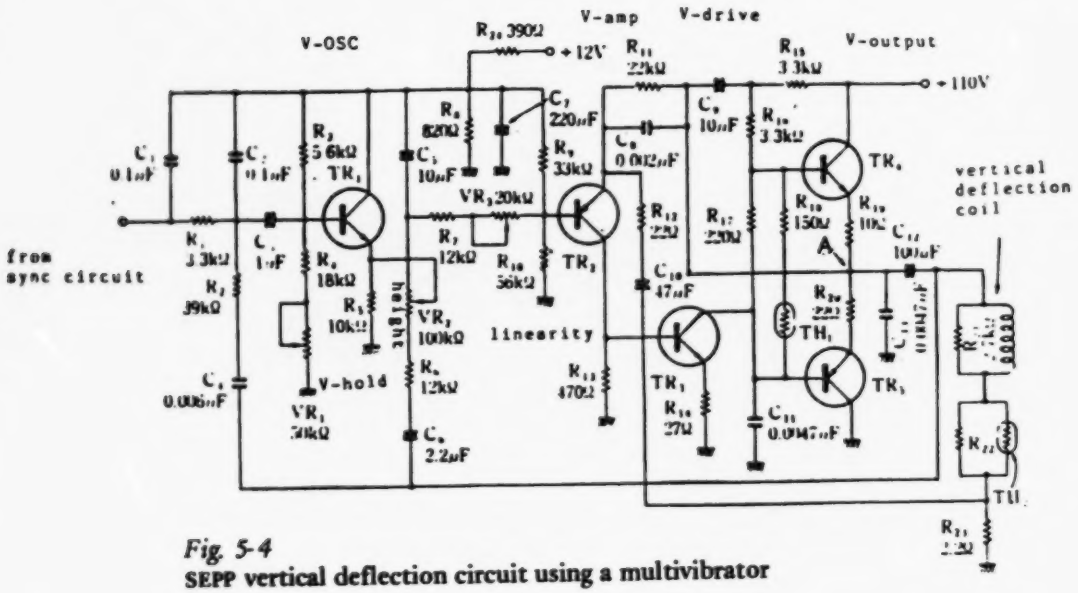


Fig. 5-4
SEPP vertical deflection circuit using a multivibrator

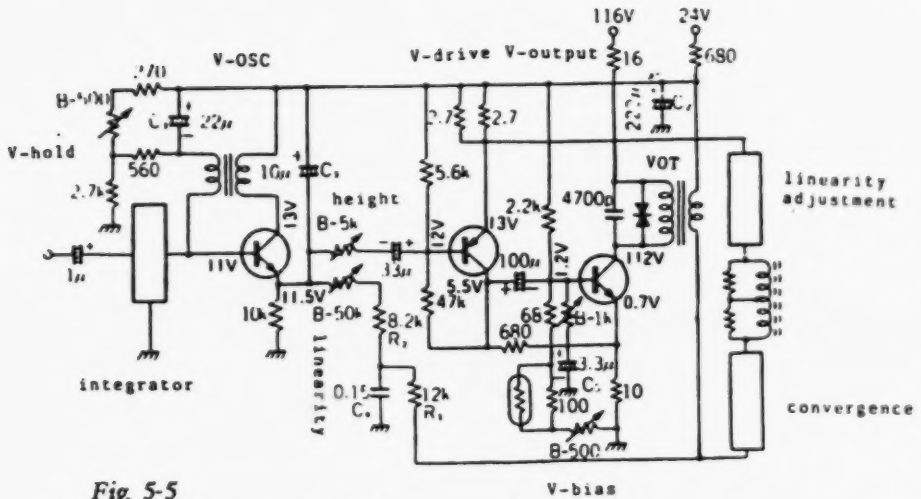


Fig. 5-5
Vertical deflection circuit

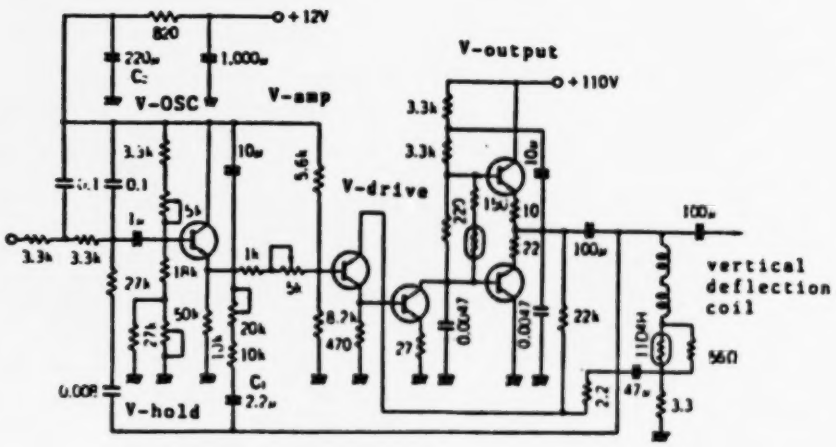


Fig. 5-6
Vertical deflection circuit with SEPP output circuit

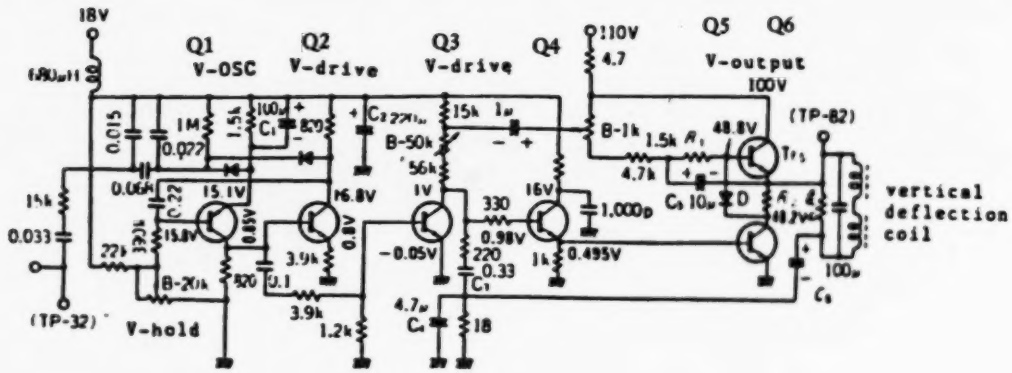


Fig. 5-7
Vertical deflection circuit with SRPP output circuit

becomes disabled and the result is no vertical deflection. On the other hand, when the emitter resistor (R20) of Tr5 becomes open, the linearity at the bottom of the raster is affected.

Appendix

The vertical output circuit shown in Fig. 5-5 is an example of a class A amplifier circuit which uses a VOT (vertical output transformer). In Fig. 5-5 the vertical output stage consists of two transistors connected in parallel. In Fig. 5-3 a single transistor is used in the vertical output stage.

The OTL (Output TransformerLess) circuit, which uses two transistors connected in a SEPP configuration and operates as a class B amplifier, is also commonly used as a vertical output circuit. Figs. 5-4 and 5-6 show typical examples of this type of circuit.

Fig. 5-7 shows a SRPP (Shunt-Regulated Push-Pull) vertical output circuit. This circuit uses two similar transistors in the vertical output stage. The trigger voltage is designed differently.

Fusible resistors are usually placed in the vertical output circuit to protect the vertical output transistors from being damaged. When the collector-emitter junction of one of the vertical output transistors is shorted, the other output transistor may get overloaded. This will result in no vertical deflection. However, this usually does not happen in modern TV receivers, since fusible resistors are used. If the collector-emitter junction of one of the vertical output transistors becomes shorted, the height of the raster decreases or the linearity of the image becomes poor.

When C5 in the SRPP vertical output circuit (Fig. 5-7) becomes open, the raster may be compressed or not, depending on the bias setting of the vertical output transistor. When C5 becomes open, the positive pulses from the vertical deflection coil are supplied to the emitter of Q5. Thus, the base-emitter junction of Q5 may get damaged.

When C5 becomes shorted, Q5 is driven to cut off owing to the loss of the base current. On the other hand, the collector of Q6 is supplied with a small current by the base circuit of Q5. Thus, Q6 conducts a little and the height of the raster decreases to around 2 to 3 cm. The same symptom results when the diode (D) in the base circuit of Q5 becomes shorted.

A shorted collector-emitter junction in Q5 results in a large collector current flow through Q6. This overloads the power supply and causes the B+ voltage to decrease. When this happens, the raster becomes dark and its size (width and height) decreases.

Whenever replacing a damaged fusible resistor, do so only with a genuine fusible resistor of the same characteristic to avoid fire hazards.

6 Fold-over

This symptom can be divided into two cases: vertical fold-over and horizontal fold-over. Vertical fold-over is more distinctive than horizontal fold-over. Vertical fold-over is characterised by a white horizontal bar on the bottom of the raster due to the concentration or compression of the trace lines on the bottom. If an image is present, the bottom portion is folded over. Horizontal fold-over is characterised by a white vertical bar on the left side of the raster. Similarly, if an image is present, the left side is also folded over.

Cause

1 ***Vertical fold-over.*** This is caused by a vertical deflection current with poor linearity, which compresses the trace lines at the bottom of the screen. This symptom is caused by a defective sawtooth wage generator circuit, or improper biasing or defective negative feedback circuit of the vertical drive or vertical output transistor. The negative feedback circuit in the vertical deflection circuit compensates for the linearity of the trace portion of the sawtooth wave.

2 ***Horizontal fold-over.*** This is caused by a sawtooth current with a considerably long retrace period.

TROUBLE-SHOOTING PROCEDURE

1 **Vertical fold-over**

First, check if the trouble can be solved by adjusting the vertical height and the vertical linearity or the sub-linearity controls alternately. Observe the effect of adjusting the user and the service controls on the symptom to make it easier in identifying the defective stage. A decrease in the capacitance of the sawtooth generator capacitor is usually the trouble. In the circuit shown in Figs. 6-1 and 6-2, a defective component in the base circuit of the vertical drive transistors will also cause the symptom.

In the circuit shown in Fig. 6-3, measure the DC drive current through the primary winding of the VOT. To do so, make a break at point A of the circuit, then connect a VOM. If the value is far from 100 mA, see if the symptom can be eliminated by setting the current to around 100 mA. This can be done by adjusting the bias control (VR).

If the symptom remains, observe the output wave-forms of the vertical oscillator, vertical amplifier, vertical drive and vertical output transistors. Refer to Picture 6-1 for examples of correct wave-forms. Common troubles are open diodes (D2 or D3), open resistors (R1 or R2) and defective vertical output transistors. Thus, these components should be fully checked. An oscilloscope is more useful than any other instrument for locating the defective stage in this circuit. After the defective stage is isolated, use a VOM to pinpoint the defective component.

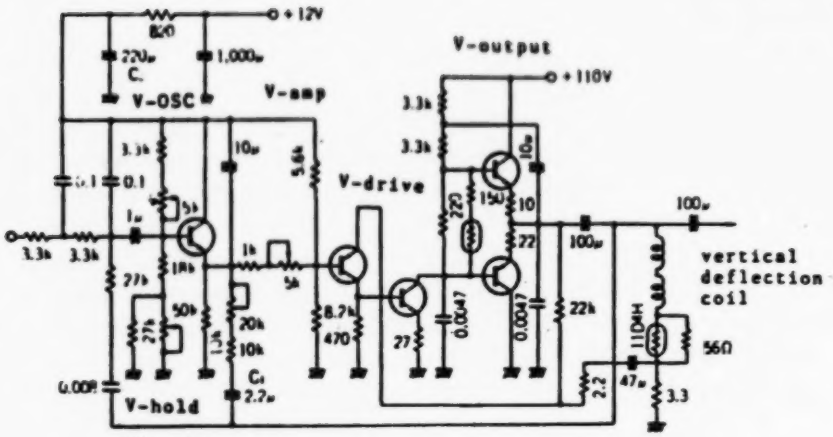


Fig. 6-1
Vertical deflection circuit

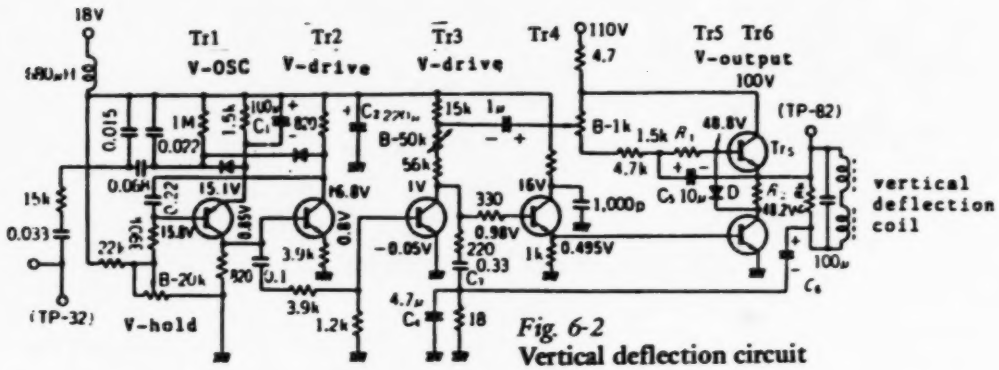


Fig. 6-2
Vertical deflection circuit

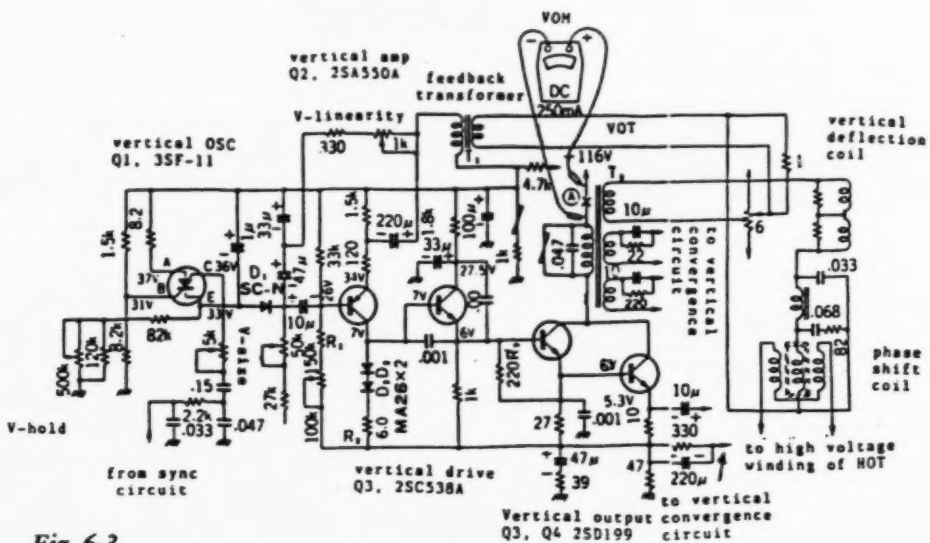
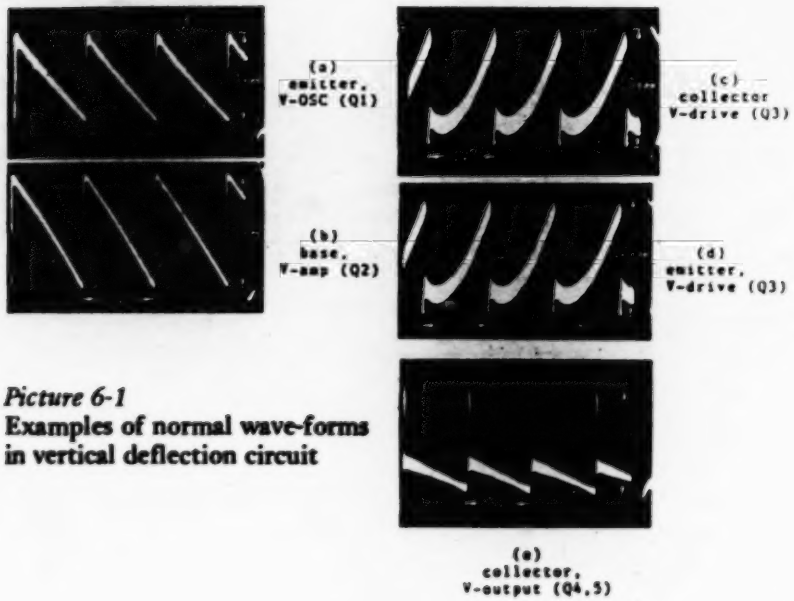


Fig. 6-3
Measurement of DC current in vertical output circuit

2 Horizontal fold-over

This symptom is not common in modern receivers and in tube receivers using a pulse width automatic frequency control (AFC) circuit for the horizontal oscillator circuit. When you encounter this symptom, you should replace the flyback transformer and the horizontal oscillator transformer to get the proper horizontal deflection blanking period. These transformers should be replaced only with transformers of the same type. However, considering the expenses and the effort in replacing the above components, it is more practical to remove the capacitor (C) connected in parallel to R in Fig. 6-4. After doing so, adjust horizontal stabilisation. Although this is not the proper way to eliminate the symptom, it is more practical and economical.



Picture 6-1
Examples of normal wave-forms in vertical deflection circuit

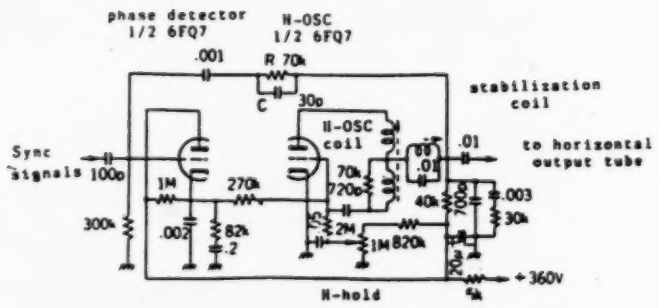


Fig. 6-4
Horizontal AFC and oscillator circuit

7 Improper synchronisation

This symptom can be divided into two cases: improper vertical synchronisation and improper horizontal synchronisation. Improper vertical synchronisation is characterised by an image that has slipped vertically out of the picture frame. The black horizontal bar in the middle of the screen is the vertical blanking signal. (See Picture 7-1.) Improper horizontal synchronisation is characterised by an image that has slipped horizontally. The unstable black vertical bar is the horizontal blanking signal. (See Picture 7-2.)

Sometimes, when horizontal sync is lost (picture tears into diagonal bars), the tearing of the picture can be compensated by the horizontal hold, but after getting synchronisation, the picture slips horizontally.

Cause: Improper vertical synchronisation is caused by a weak vertical sync signal owing to a trouble in the coupling circuit between the integrator and the vertical oscillator circuits. A decrease in the capacitance of the coupling capacitor of the sync amplifier circuit or a trouble in the integrator circuit may also cause the symptom.

Improper horizontal synchronisation may be due to the absence of the horizontal sync signal supply for the AFC detector circuit.

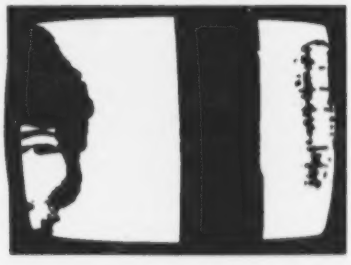
TROUBLE-SHOOTING PROCEDURE

1 **Improper vertical synchronisation**

Check the condition of the coupling capacitors (C1 and C2) in the sync separator and in the sync amplifier circuit in Fig. 7-1. Usually, this symptom is due to the decrease in the capacitance of these capacitors. It is better to shunt them with a good capacitor in order to check their condition and whether they are the source of the trouble or not.

A defective stage in the sync circuit is easily identified with the aid of an oscilloscope. Refer to Picture 7-3 for examples of correct and faulty wave-forms. The proper base wave-forms of the sync separator and the sync splitter transistors are given in (a) and (c), respectively. If the capacitance of C1 and C2 has

Picture 7-1



Picture 7-2

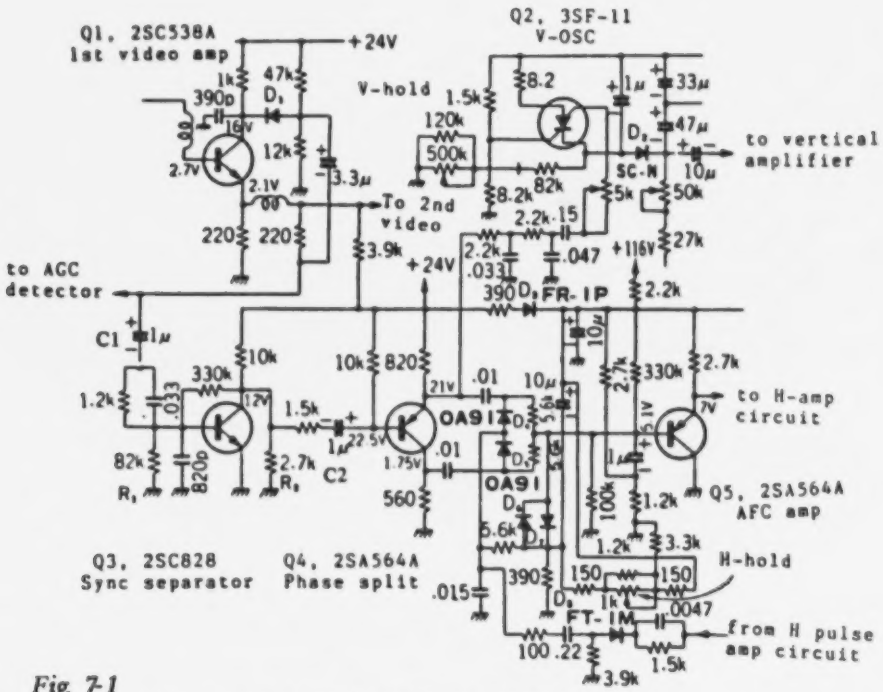
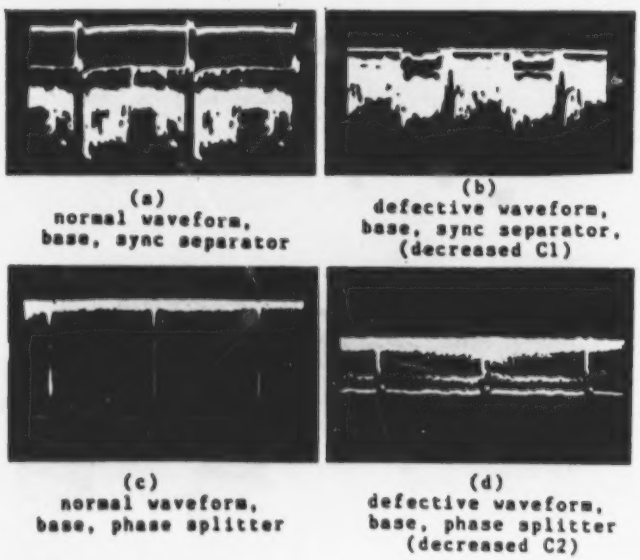


Fig. 7-1
Sync, vertical and horizontal oscillator circuit



(a)
normal waveform,
base, sync separator

(b)
defective waveform,
base, sync separator,
(decreased C1)

(c)
normal waveform,
base, phase splitter

(d)
defective waveform,
base, phase splitter
(decreased C2)

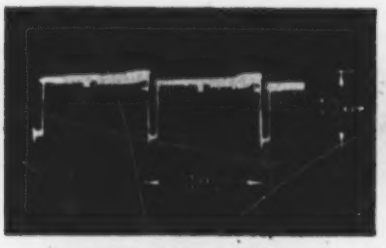
Picture 7-3
Normal and defective wave-forms in sync circuit

decreased, the sync signal component of the composite video signal becomes compressed, as shown in Pictures 7-3(b) and (d).

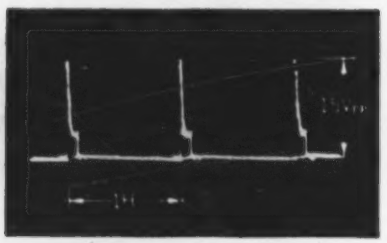
If the coupling capacitors (C1, C2) are in good condition, check the resistors in the integrator circuit (R1, R2), and for leaky bypass capacitors (C3, C4).

2 Improper horizontal synchronisation

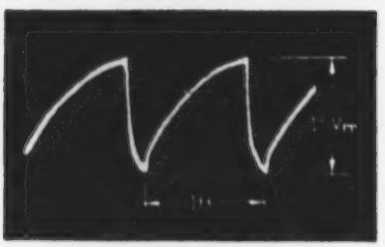
Observe the wave-forms at nodes A and B of the sync splitter stage in Fig. 7-1. Refer to Pictures 7-4(a) and (b) for the correct wave-forms. If a faulty wave-form is observed, trouble-shoot the sync splitter circuit. Otherwise, if the wave-forms are normal, check the wave-form at node C. The correct wave-form is given in Picture 7-4(c). If a faulty wave-form is observed at node C, check the components of the comparator circuit (R3, R4, C5 and D8).



(a) Wave-form at A



(b) Wave-form at B



(c) Wave-form at C

Picture 7-4
Normal wave-forms in the circuit shown in Fig. 7-1

8 No horizontal and vertical synchronisation

This symptom is characterised by a continuously rolling picture that is torn into diagonal bars, as shown in Picture 8-1. The horizontal and the vertical hold controls have no effect on the symptom.

Cause: This symptom is usually caused by a defective sync separator or sync amplifier circuit. Sometimes a trouble in the AGC circuit and in the noise-cancelling circuit may also cause the symptom.

TROUBLE-SHOOTING PROCEDURE

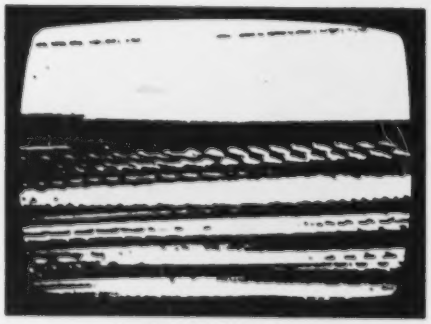
a **Solid-state circuits**

Check if the symptom can be tolerated by changing the setting of the AGC control and then adjusting the horizontal and vertical hold controls.

If synchronisation cannot be obtained, trouble-shoot the sync separator and the sync amplifier circuits. If these circuits are confirmed to be operating properly, trouble-shoot the AGC and the noise-cancelling circuits. Refer to the trouble-shooting flow chart shown in Fig. 8-1.

1 ***Trouble-shooting the sync circuit***

Observe the processing of the sync signals with the aid of an oscilloscope and a VOM. Observe the wave-forms and measure the voltage at the terminals of the sync separator and the sync amplifier transistors (Q3 and Q4) in the circuit in Fig. 8-2.



Picture 8-1

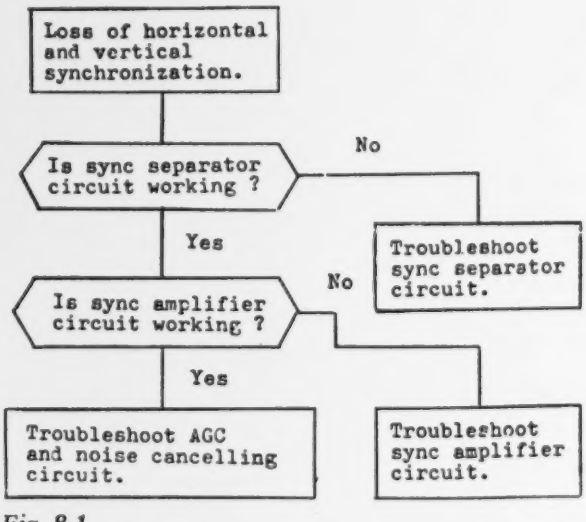


Fig. 8-1
Trouble-shooting flow chart for no synchronisation

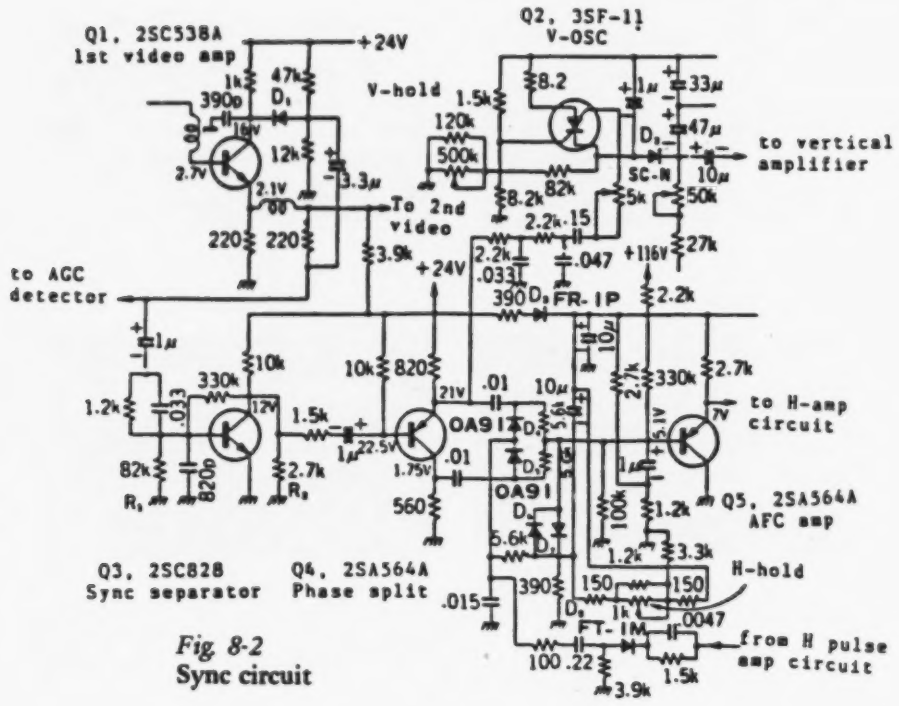


Fig. 8-2
Sync circuit

An efficient way to observe the processing of the sync signals is to start observing the signal at the base and then at the collector and emitter of the sync separator transistor (Q3) and of the sync amplifier transistor (Q4). If any wave-form shows a compressed sync signal as shown in Picture 8-3(b), use a VOM to pinpoint the defective component in the circuit of the defective stage.

Picture 8-2 shows the normal wave-forms of the sync circuit. Node voltages and the most likely defective components are also given in Fig. 8-2.

2 *Trouble-shooting the AGC circuit*

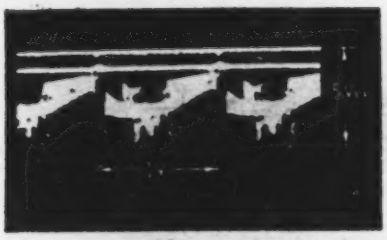
Observe the video detector output wave-form at the base of the first video amplifier transistor (Q1) as shown in Fig. 8-3 and vary the setting of the AGC control.

If the AGC circuit is operating properly, a good and clear composite video signal can be observed as shown in Picture 8-3(a) at a particular setting of the AGC control. If the AGC circuit is defective, the sync signal component of the composite video signal is compressed, as shown in Picture 8-3(b).

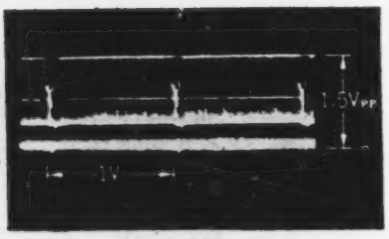
If the AGC circuit is defective, check the components indicated with arrows in Fig. 8-4.

3 *Trouble-shooting the noise-cancelling circuit*

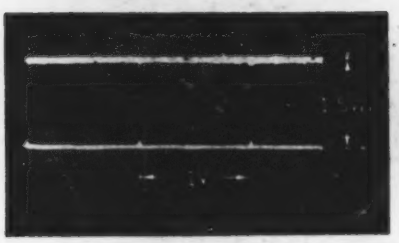
In the noice-cancelling circuit shown in Fig. 8-2, an open resistor (R1 or R2), a shorted or open diode (D1) or a shorted capacitor (C1) are the most likely defective components. Use a VOM to locate the defective component.



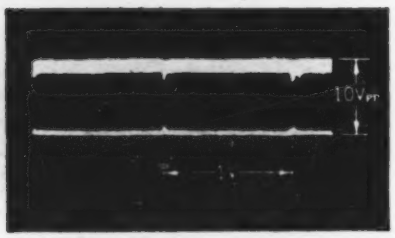
(a)
base, sync
separator (Q3)



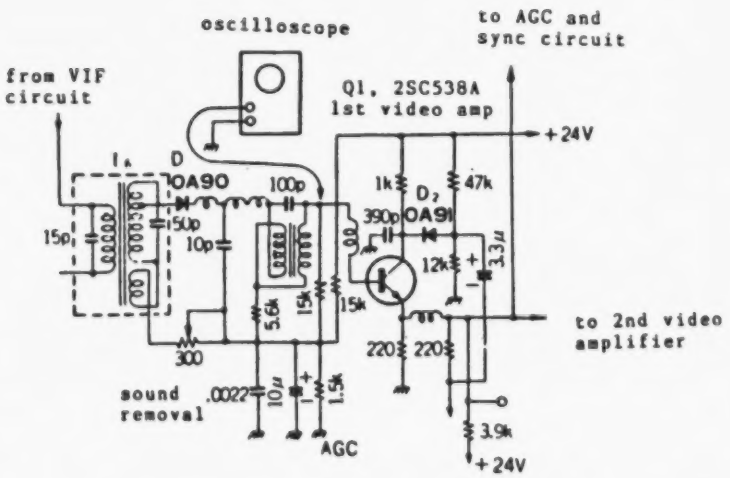
(c)
collector, sync
splitter (Q4)

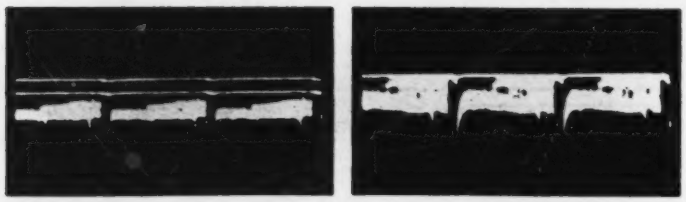


(b)
collector,sync
separator (Q3)
and base, sync
splitter (Q4)



(d)
emitter, sync
splitter (Q4)





(a)
normal waveform

(b)
defective waveform
(sync signal is
compressed)

Picture 8-3
Examples of normal and defective wave-forms in sync circuit

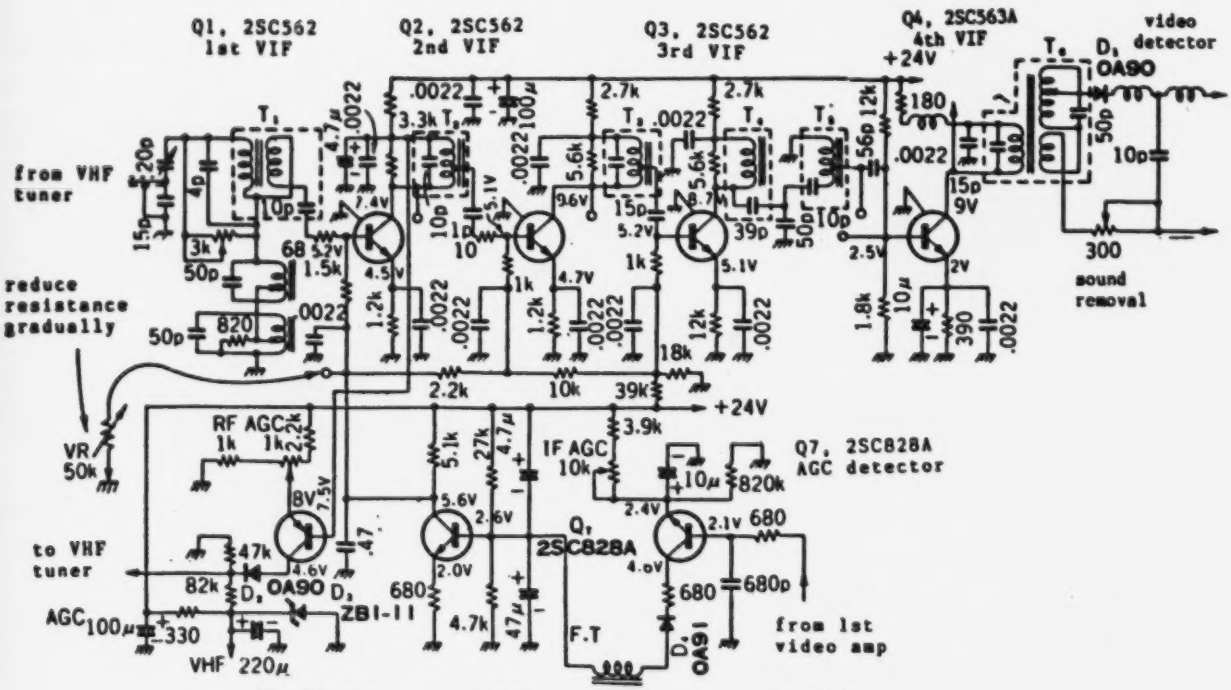


Fig. 8-4
VIF and AGC circuit

Technical memo

Another way to identify a breakdown in the AGC circuit is to connect a variable resistor (50 kilo ohm) between the AGC line and ground. If the picture becomes normal when the variable resistor is adjusted to a small resistance value, the trouble is in the AGC.

b IC circuits

The trouble-shooting procedures, flow chart and the usually defective components in IC receiver circuits are similar to those in transistor circuits. A trouble-shooting procedure for the IC circuit in Fig. 8-5 will be discussed.

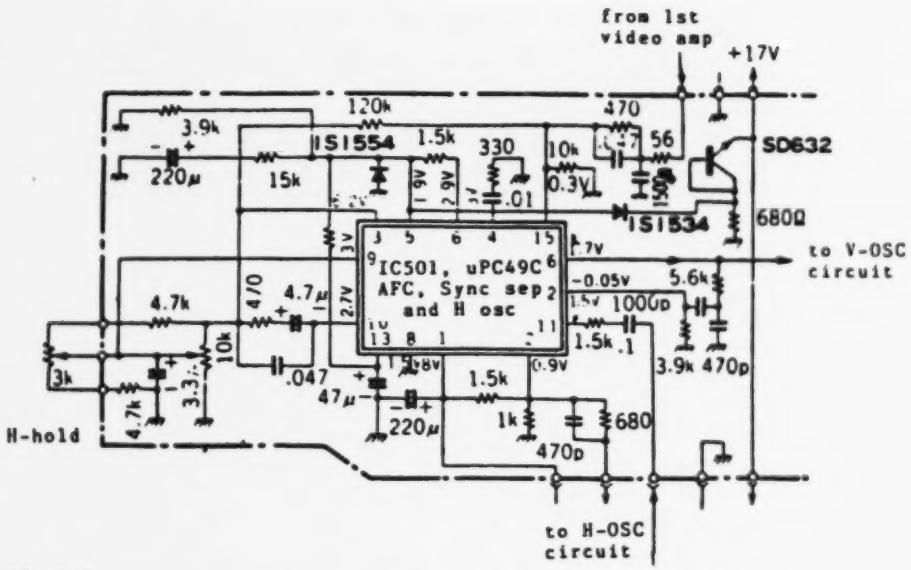


Fig. 8-5
IC AFC, sync separator and horizontal oscillator circuit

Trouble-shooting IC501

As shown in Fig. 8-5, IC501 (uPC49C) functions as a sync separator and a sync amplifier. The composite video signal is supplied to pin no. 15 and the output sync signal is taken at pin no. 16. To check the condition of the circuit, observe the wave-form at pins no. 15 and 16. Fig. 8-6 shows examples of correct wave-forms. If a correct video signal wave-form is observed at pin no. 15 but a correct sync signal is not observed at pin no. 16, the trouble is in the surrounding circuit of the IC or the IC itself.

Measure the pin voltages and resistance of the IC relative to ground. The normal values are shown in Fig. 8-6. The usually defective components are indicated with arrows in the circuit. If all the surrounding components are confirmed to be in good condition, replace the IC.

Technical memo

A signal tracer can be used to check the input and the input signals of the IC. If a buzzing sound can be heard from pin no. 15 but not from pin no. 16, then IC501 or its surrounding circuit is defective.

Reference

In some cases, when measuring IC pin voltages, the operation of the IC circuit is much affected by the internal resistance of the VOM. Usually the pin voltages are low, thus the VOM is set at lower voltage ranges. At lower voltage ranges, the internal resistance of the VOM is considerably low. For example, IC501 includes the horizontal oscillator circuit aside from the AFC and the sync circuits.

If the output pin voltage is measured, the horizontal deflection circuit be-

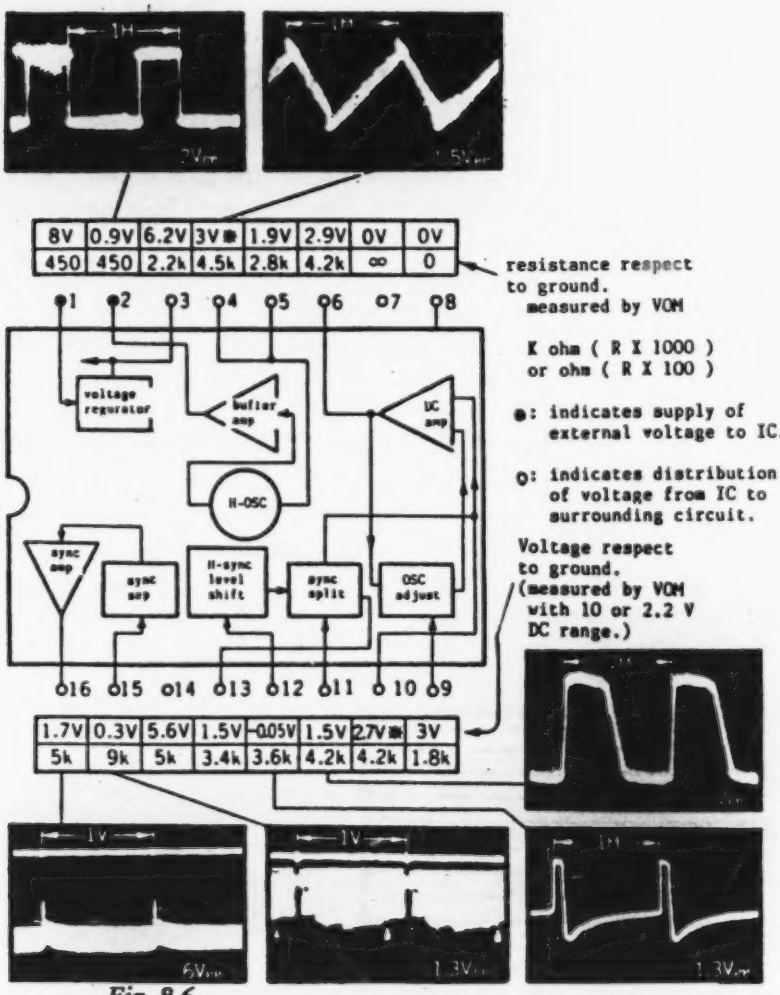

8V 0.9V 6.2V 3V● 1.9V 2.9V 0V 0V
450 450 2.2k 4.5k 2.8k 4.2k ∞ 0
resistance respect to ground. measured by VOM
K ohm (R X 1000) or ohm (R X 100)
●: indicates supply of external voltage to IC.
○: indicates distribution of voltage from IC to surrounding circuit.
Voltage respect to ground. (measured by VOM with 10 or 2.2 V DC range.)
voltage regulator
buffer amp
I/C amp
H-OSC
sync amp
sync sep
H-sync level shift
sync split
OSC adjust
1.7V 0.3V 5.6V 1.5V -0.05V 1.5V 2.7V● 3V
5k 9k 5k 3.4k 3.6k 4.2k 4.2k 1.8k

Fig. 8-6
Normal voltage, resistance and wave-forms in IC 501

comes overloaded due to the small internal resistance of the VOM, which shunts the output pin to ground. When this happens, a fuse connected to the B+ line blows.

Another example is when the voltage of pin no. 4 is measured relative to ground. When a VOM is connected across pin no. 4 and ground, the oscillation frequency changes due to the small internal resistance of the VOM connected between pin no. 4 and ground. A change in the oscillation frequency of the horizontal oscillator may result in excessive current in the horizontal deflection circuit and cause a fuse to blow. Thus it is important to have the technical data of the IC circuit. Before measuring pin voltages, check if such measurement will affect the operation of the IC. Set the VOM to the higher voltage ranges or, better still, use an oscilloscope.

Make sure that the pins of the IC are not shorted by the probes of the measuring instrument. Always use pointed or needle-sharp probes.

9 No horizontal synchronisation

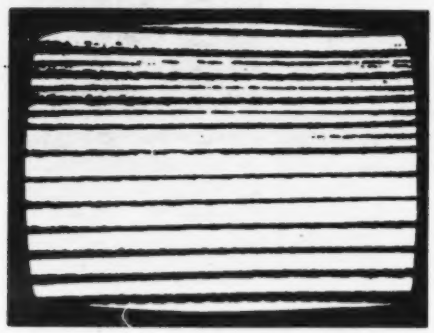
This symptom is characterised by the tearing of the picture into diagonal bars on the screen, as shown in Picture 9-1. The horizontal hold has no effect on the symptom.

Cause: This symptom is caused by a defective phase splitter circuit, AFC amplifier circuit or horizontal oscillator circuit.

TROUBLE-SHOOTING PROCEDURE

a Solid-state circuits

If the horizontal hold control and the core of the horizontal oscillator transformer are one and the same, skip the rest and proceed to the next paragraph. Otherwise, if the horizontal hold control is a variable resistor, set it in mid-position and try to eliminate the symptom by adjusting the core of the horizontal oscillator transformer. If the tearing of the picture is eliminated but the picture slides sideways out of the picture frame, proceed with the trouble-shooting procedure in the next paragraph.



Picture 9-1

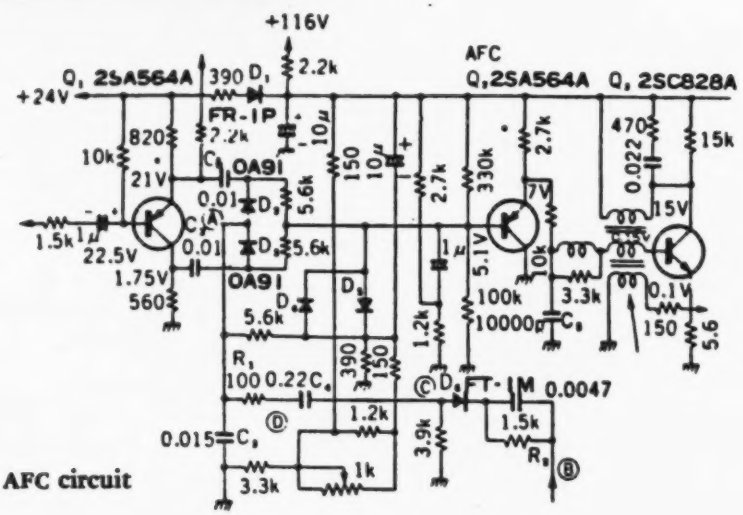
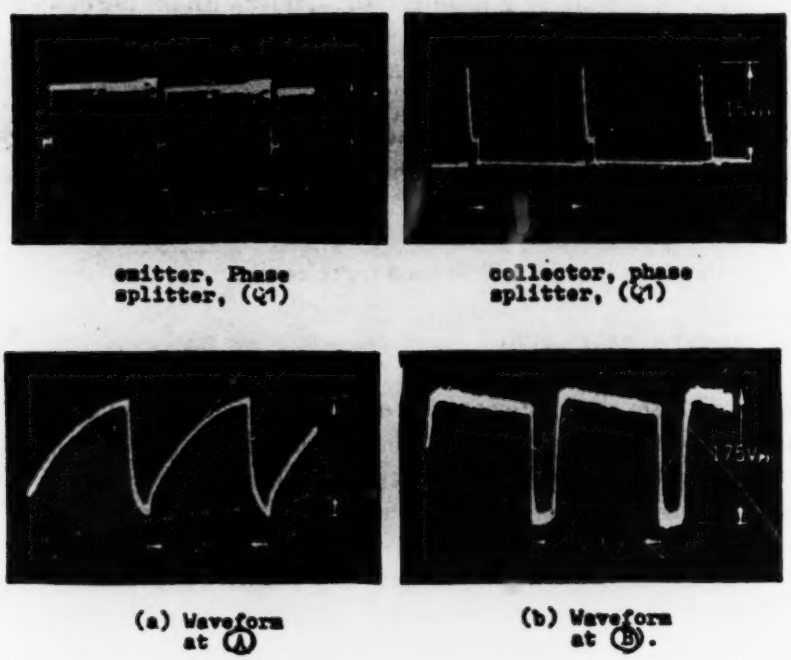


Fig. 9-1
Horizontal AFC circuit



emitter, Phase splitter, (Q1)

collector, phase splitter, (Q1)

(a) Waveform at (A)

(b) Waveform at (B).

Picture 9-2
Normal wave-forms in phase splitter

Observe the wave-forms at the collector and the emitter of the phase splitter transistor (Q1) in Fig. 9-1. The normal wave-forms for this circuit are shown in Picture 9-2. If an incorrect wave-form is observed, check the capacitors (C1, C2) and the diodes (D2, D3) in the phase-detector circuit.

If the emitter and collector wave-forms are correct, observe the sawtooth wave-form at node A. Refer to Picture 9-3 for the correct wave-form. If the wave-form is incorrect, check the components of the signal generator circuit (R1, R2, C3, C4 and D6).

Other possible defective components are defective diodes (D4, D5), shorted emitter-base junction in the AFC amplifier transistor (Q2) and shorted capacitor (C5) in the base circuit of the horizontal oscillator.

Technical memo

1 It is easier and faster to identify the defective stage with an oscilloscope. After identifying the defective stage, use a VOM for voltage measurements and continuity tests to identify the defective component.

2 In testing the capacitors (C1, C2) and the diodes (D2, D3) in the phase-detector circuit for a leak, disconnect one end of the component from the circuit to get a proper reading. Generally, in transistor circuits, when doing an in-circuit continuity test, the ohmmeter reading is much affected by the surrounding resistors with very low resistance values. To get proper resistance readings and continuity tests, disconnect one end of the component first from the circuit.

3 If the wave-form at node A is incorrect, signal trace with the use of an oscilloscope. Trace the sync signal starting at node B and then at nodes C and D in Fig. 9-1. If an incorrect wave-form is observed at any of these nodes, check the surrounding components.

The components indicated with arrows in Fig. 9-1 are most likely defective. The proper voltages are also included in the diagram.

b IC circuits

The diagram shown in Fig. 9-2 will be used for reference.

TROUBLE-SHOOTING PROCEDURE

If the horizontal hold control is different from the core of the horizontal oscillator transformer, set the hold control in mid-position and then adjust the sub-horizontal hold control (core of the oscillator transformer). If you cannot get horizontal synchronisation, observe the wave-forms of IC501. The normal wave-forms, voltages and resistance of the IC pins relative to ground are given in Fig. 9-3. In trouble-shooting the IC horizontal oscillator circuit, the wave-forms and voltage measurements may sometimes appear to be normal and thus will not give away the defective component. In this case, the defective component can be found only by making continuity or resistance tests.

Technical memo

1 When R1 in Fig. 9-2 is open, the pin voltages and wave-forms of IC501 remain close to normal. Therefore, the defective component cannot be identified by voltage measurements and wave-form observations alone.

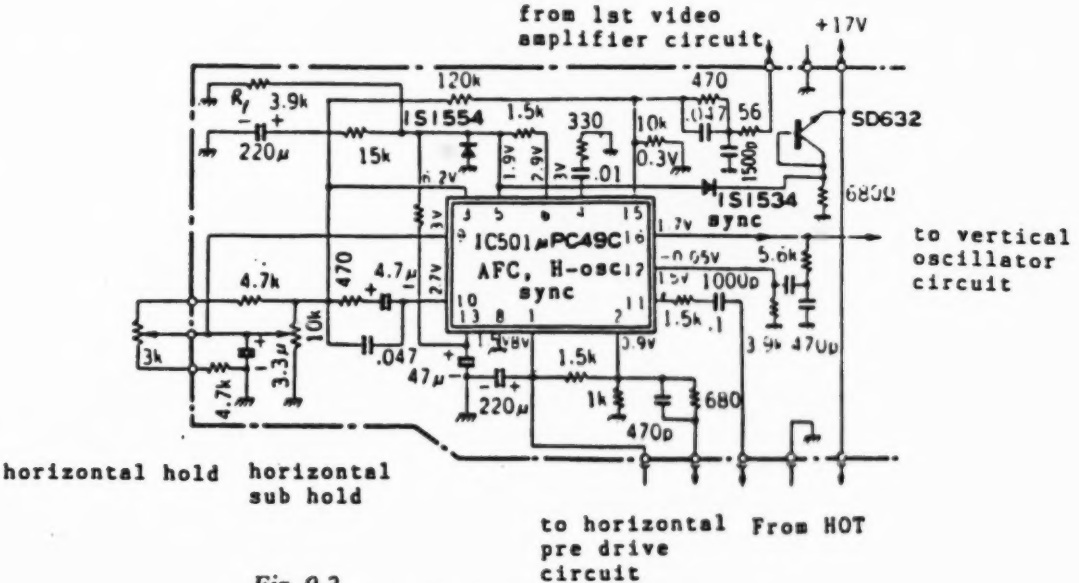


Fig. 9-2
IC sync, AFC and horizontal oscillator circuit

However, when R1 is open, the resistance of pins no. 5, 6 and 13 relative to ground changes.

2 When the horizontal sync signal is not supplied to IC501 or when the surrounding components (R7, R8, C3) of pin no. 12 are defective, the tearing of the picture can be eliminated by the horizontal hold, but the picture moves sideways.

On the other hand, if the horizontal oscillation frequency shifts so far from the horizontal sync frequency, the tearing of the picture cannot be eliminated by the horizontal hold adjustment. The defective components usually are R1, R2, R3, R4, R5, C1 and C2. Refer to Fig. 9-2.

Other components that may be defective are indicated with arrows.

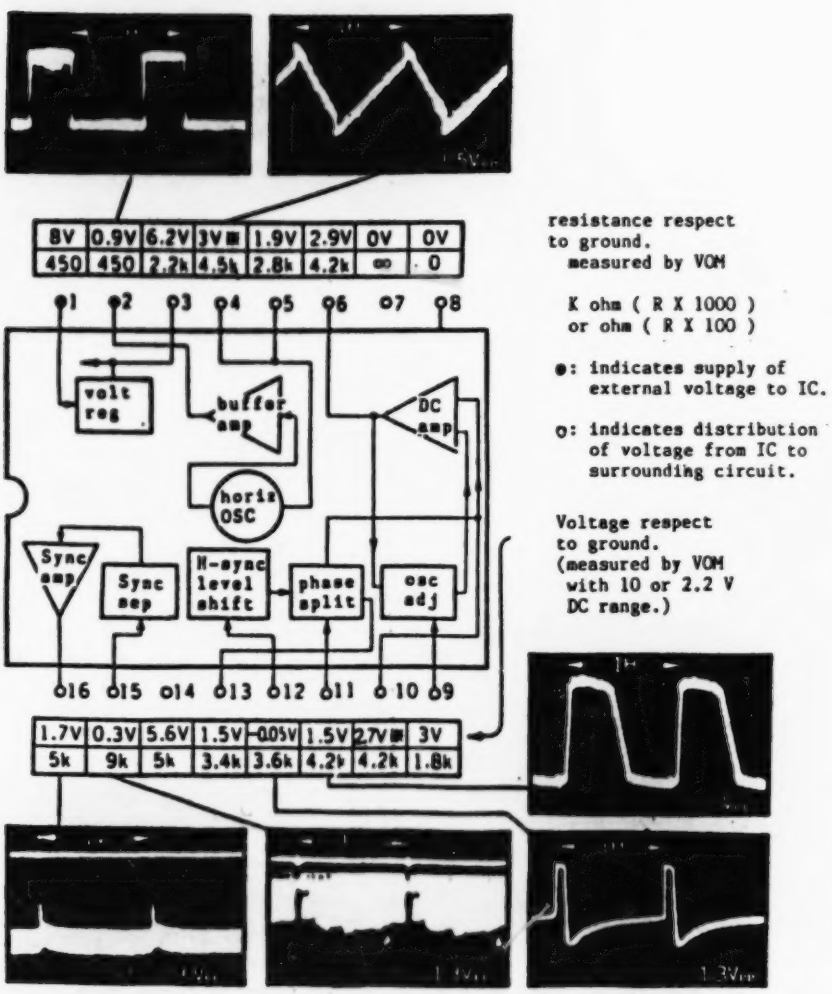

8V 0.9V 6.2V 3V 1.9V 2.9V 0V 0V
450 450 2.2k 4.5k 2.8k 4.2k ∞ 0
1 2 3 4 5 6 7 8
volt reg
buffer amp
DC amp
horiz OSC
Sync amp
Sync sep
H-sync level shift
phase split
osc adj
16 15 14 13 12 11 10 9
1.7V 0.3V 5.6V 1.5V -0.05V 1.5V 2.7V 3V
5k 9k 5k 3.4k 3.6k 4.2k 4.2k 1.8k
resistance respect to ground. measured by VOM
K ohm (R X 1000) or ohm (R X 100)
●: indicates supply of external voltage to IC.
○: indicates distribution of voltage from IC to surrounding circuit.
Voltage respect to ground. (measured by VOM with 10 or 2.2 V DC range.)

Fig. 9-3
Normal voltage, resistance and wave-forms at IC 501

10 Part of image is out of synchronisation

This symptom is also called partial horizontal synchronisation. It is characterised by the partial tearing of the picture. The part of the picture where tearing occurs varies with movements or changes in the picture.

Cause: This symptom is caused by the presence of the video signal in the horizontal AFC circuit. If the sync separator does not operate well, the video signal component is not completely filtered from the sync signal supplied to the AFC circuit. A defective sync circuit or AGC circuit may cause the symptom.

TROUBLE-SHOOTING PROCEDURE

First, adjust the AGC control. If the symptom cannot be eliminated, observe the wave-form at the base of the sync separator transistor (Q3) in Fig. 10-1. Refer to Picture 10-1(a) for the correct wave-form for this circuit. If a distorted wave-form (sync signals are compressed) as shown in Picture 10-3, trouble-shoot the first video amplifier and the AGC circuit.

If the wave-form is normal, observe it at the collector and emitter of the sync separator and the sync amplifier [phase splitter] transistors (Q3 and Q4). The normal wave-forms are shown in Picture 10-1.

If the sync signal has traces of video signal components, check the condition of Q3. The base or the collector resistor (R1 or R2) may be open.

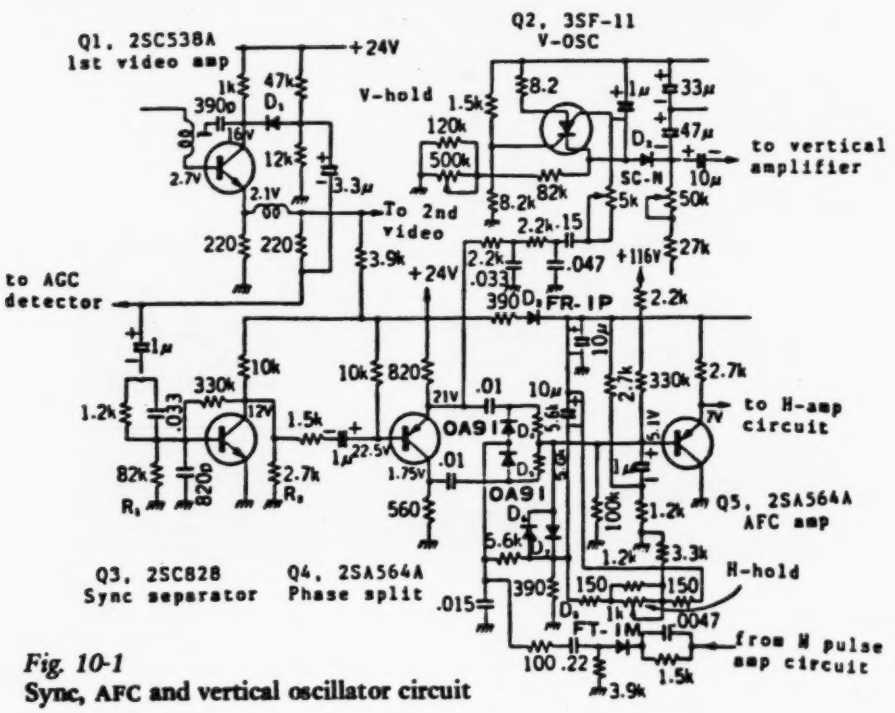
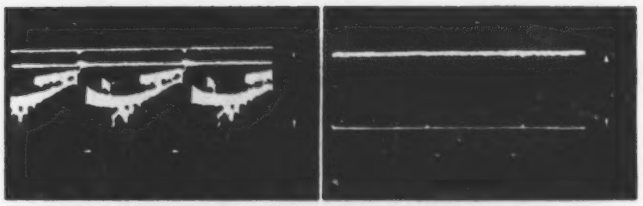


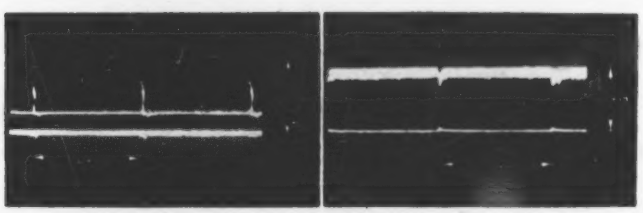
Fig. 10-1
Sync, AFC and vertical oscillator circuit



(a) Base, sync separator.

(b) collector, sync separator.

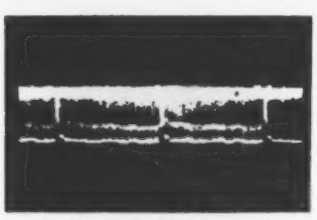
Picture 10-1
Normal wave-forms at sync separator



(c) collector, sync splitter.

(d) emitter, sync splitter.

Picture 10-2
Normal wave-forms in sync splitter



Picture 10-3
Distorted sync signals

Technical memo

To check the sync signal for traces of video signal components, set the horizontal sweep sensitivity of the oscilloscope to one period of the vertical field of the video signal and set the vertical sensitivity to around 2 to 3 V. A wavy movement between the bottom and the peak portion of the sync signal indicates the presence of video signal components. Normal wave-forms are shown in Picture 10-1; distorted wave-forms, in Picture 10-3.

11 Insufficient horizontal deflection

This symptom is characterised by a raster with insufficient width as indicated by black vertical bars on both sides of the screen. This symptom is sometimes accompanied with poor focus.

Cause: This symptom is caused by a horizontal deflection sawtooth current with insufficient strength due to a breakdown or an overload in the horizontal deflection circuit. A low B+ voltage may also cause the symptom.

TROUBLE-SHOOTING PROCEDURE

First, adjust the horizontal width control (if any) to get a sufficient raster width. If you cannot get a normal raster width, measure the B+ supply voltage of the horizontal deflection circuit. If the B+ voltage is lower than normal, adjust the DC output voltage control and set the B+ voltage to its normal voltage, as indicated in the diagram.

If the B+ voltage is low and cannot be adjusted to its correct value, check the components indicated with arrows in the power-supply circuit in Fig. 11-2.

If the B+ voltage is normal, check the horizontal output transistor (Q2 or Q3) in Fig. 11-1.

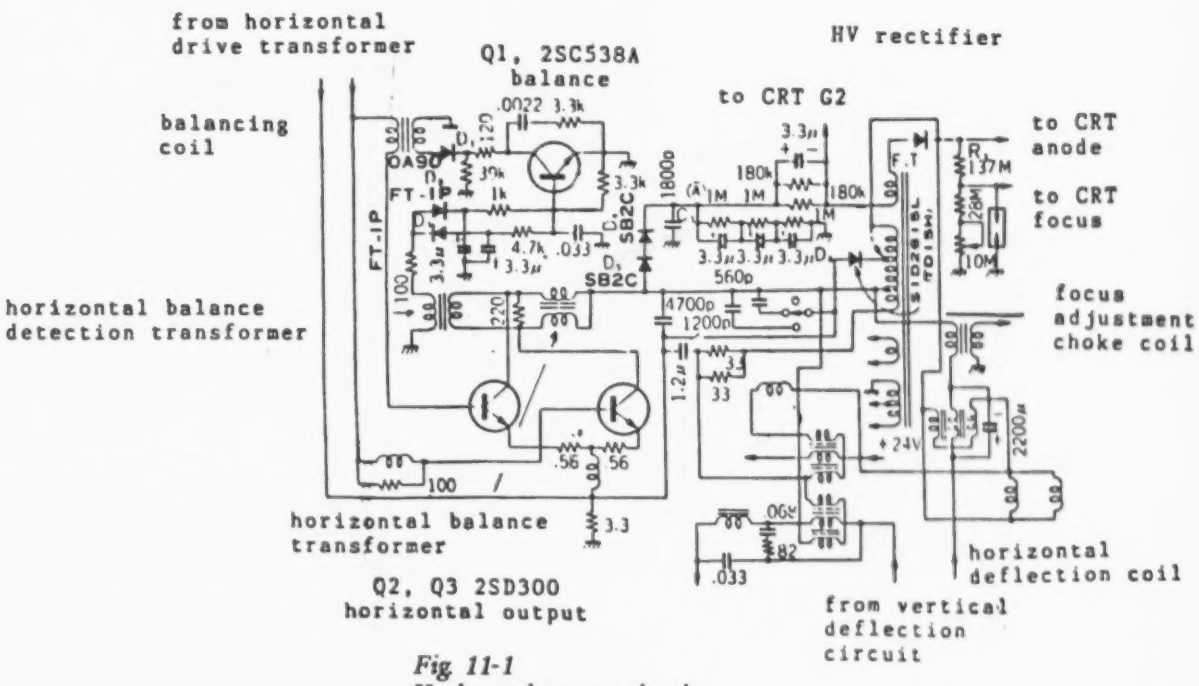


Fig. 11-1
Horizontal output circuit

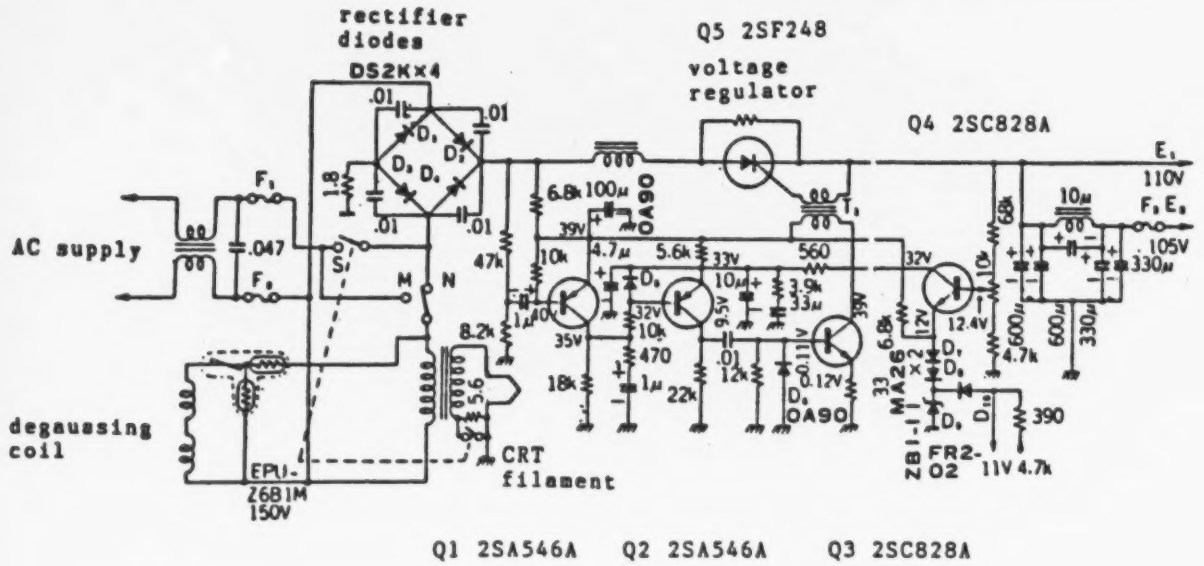


Fig. 11-2
Power-supply circuit

Technical memo

1 The B+ voltage of the horizontal output circuit can be measured at node A in Fig. 11-1 or at terminal E2 in Fig. 11-2. If the voltage measured is at least 10 V less than what is indicated, the power supply may be defective.

2 If the B+ voltage is low due to a defective power-supply circuit, the focus of the image on the screen becomes poor. If the rectifier circuit in the power-supply circuit is defective, the height of the raster also decreases.

3 In solid-state receivers, this symptom is rarely caused by a defective horizontal output circuit. Usually, when the horizontal output circuit becomes defective, the high voltage is lost (no raster).

12 Wavy vertical edges

This symptom is characterised by images with scalloped edges (wavy sides) and is also called hunting or pie-crust effect.

Cause: Wavy vertical edges are caused by a misadjustment in the horizontal AFC circuit. A breakdown in the integrated circuit of the AFC phase-detector output circuit may also cause the symptom.

TROUBLE-SHOOTING PROCEDURE

First, adjust the horizontal stabilisation coil. If the symptom cannot be eliminated, check for an open resistor (R) or capacitor (C) in the integrator circuit in Figs. 12-1 or 12-2. An open resistor can be easily detected with a VOM. If an open capacitor is suspected, shunt it with a good one.

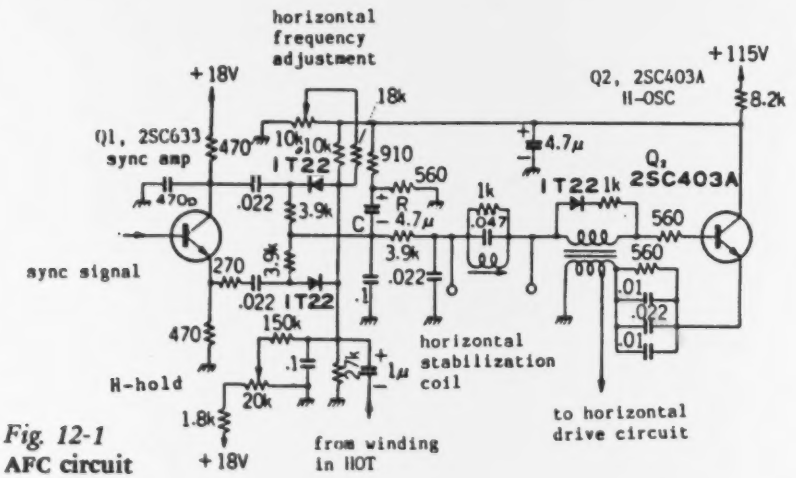


Fig. 12-1
AFC circuit

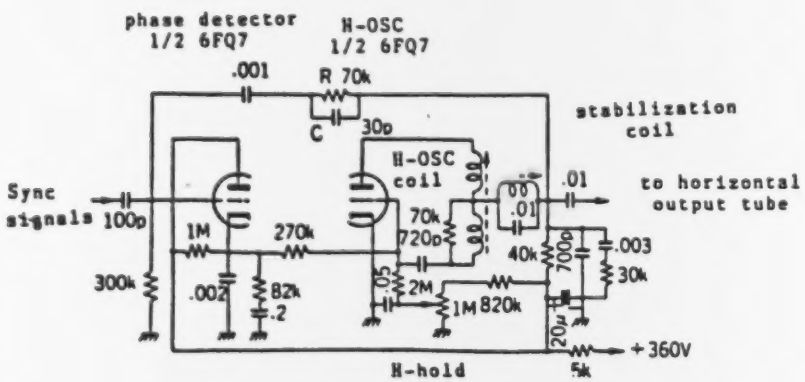


Fig. 12-2
AFC and horizontal oscillator circuit

13 Christmas-tree effect (horizontal trigger oscillation)

This symptom is characterised by disordered horizontal scanning lines that form the raster as indicated by images that seem to be overlapping. (See Picture 13-1.) This symptom is usually accompanied with a high-pitched hissing sound.

Cause: In vacuum and solid-state receivers, this symptom is caused by a de-tuned horizontal stabilising circuit. Therefore, adjusting the core of the horizontal stabilising coil will solve the problem most of the time.

TROUBLE-SHOOTING PROCEDURE

a Solid-state circuits

Short the horizontal stabilising coil with a clip cord and check the raster. If the raster goes back to normal after shorting this coil, the coil is misadjusted.

Technical memo

Adjustment of the horizontal AFC circuit

In the circuit shown in Fig. 13-1, set the horizontal hold control knob in mid-position. After doing so, short the stabilising coil and adjust the horizontal frequency control. After getting a normal raster, remove the short across the stabilising coil and synchronise the picture by adjusting the synchronisation coil (horizontal hold).

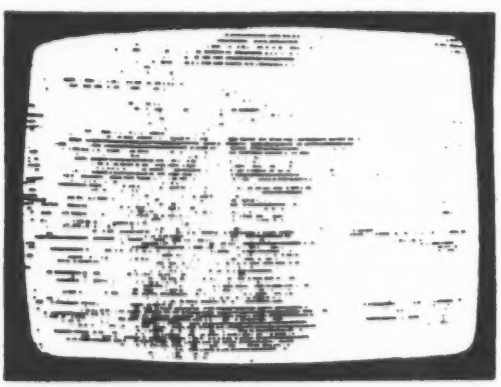
Reference

Besides the misadjustment of the stabilising coil, an open C1, C2, R1, R2 or a change in the operating point of the horizontal oscillator transistor will shift the oscillation frequency and cause the symptom.

b Vacuum tube circuits

Adjusting the pulse width AFC circuit

The horizontal trigger oscillation often occurs in circuits using pulse width AFC



Picture 13-1

circuit. In the circuit in Fig. 13-2, short the stabilising coil with a clip cord. If the raster becomes normal, the stabilising coil is misadjusted.

Set the horizontal sync control in mid-position and short the stabilising coil with a clip cord. Adjust the upper core of L1. If a normal raster cannot be obtained, check the horizontal oscillator tube, grid resistor (R1) and the grid capacitor (C1). If a normal raster is obtained after adjusting the upper core of L1, disconnect the short across the stabilising coil and then adjust the lower core of L1 for a properly synchronised image.

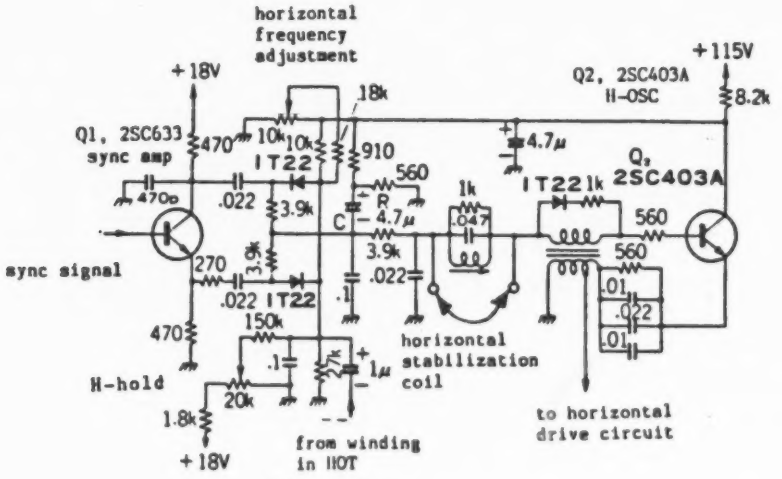


Fig. 13-1
AFC circuit

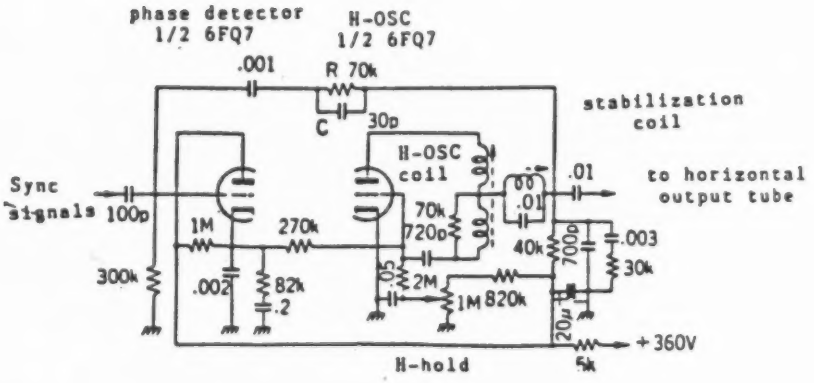


Fig. 13-2
AFC and horizontal oscillator circuit

14 No horizontal deflection

This symptom is characterised by a thin vertical line in the middle of the screen as shown in Picture 14-1.

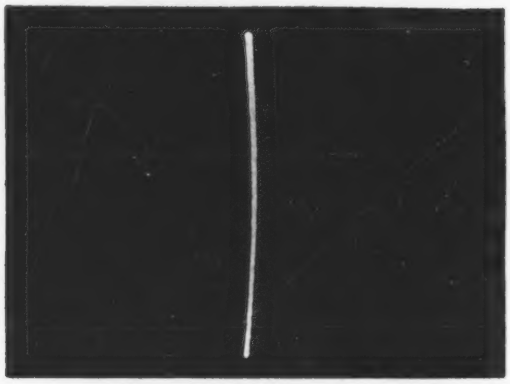
Cause: This symptom is caused by the absence of the deflection sawtooth current in the horizontal deflection coil.

TROUBLE-SHOOTING PROCEDURE

The trouble is easily isolated by a continuity test and by checking the most likely defective components in Fig. 14-1 such as a) open vertical linearity compensation transformer, b) open capacitor and c) open horizontal deflection coil. These components are indicated with arrows in the figure.

Technical memo

Be sure to decrease the brightness first before trouble-shooting if the line is very bright, as it may burn the phosphor screen.



Picture 14-1

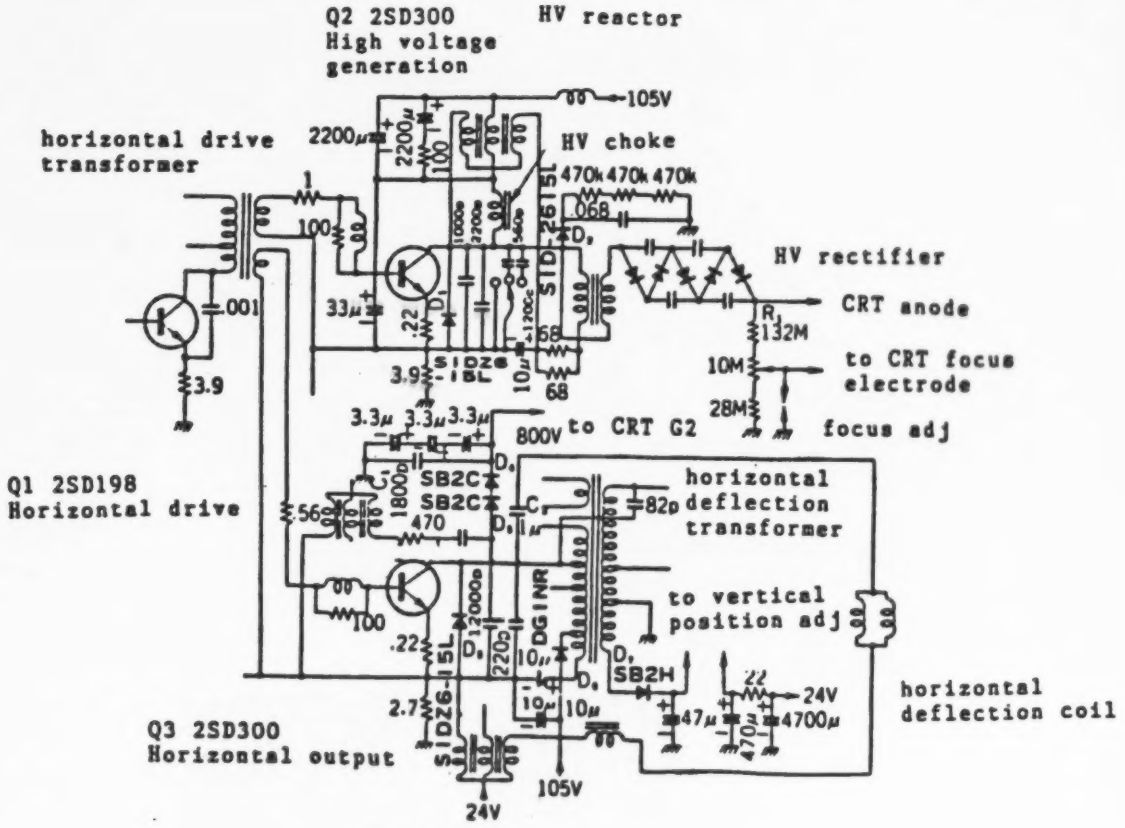


Fig. 14-1
Horizontal output circuit

15 No image

This trouble is characterised by the loss of the image or by the loss of the image and sound. In either case, a full raster is present, as shown in Picture 15-1.

Cause of no image: This symptom is mainly caused by troubles in the video amplifier circuit. However, troubles in the VIF or in the RF amplifier circuit may also cause the symptom.

No image and sound: In most cases, this symptom is caused by a breakdown in the local oscillator circuit. In fringe areas where the broadcast signals are weak, the trouble may be in the RF or in the VIF amplifier circuit.

TROUBLE-SHOOTING PROCEDURE

a **Solid-state circuits**

If only the image is missing, trouble-shoot from the video amplifier circuit towards the VIF circuit up to the RF amplifier circuit. If the image and sound are missing, check the local oscillator first. If the local oscillator is operating properly, trouble-shoot the RF amplifier, the VIF amplifier and then the video amplifier circuit in that order.

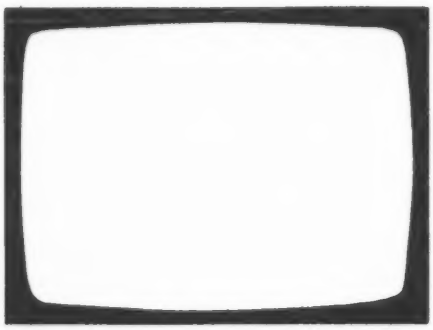
Check also the AGC circuit, since a trouble in this circuit may also cause the symptom. For an efficient trouble-shooting procedure, refer to the flow chart shown in Fig. 15-1.

1 ***Trouble-shooting the video amplifier circuit***

Short the base and the emitter of the first video amplifier transistor (Q1) with a clip cord momentarily and repeatedly as shown in Fig. 15-2. If raster flickers while doing so, the video amplifier circuit is operating properly.

If a signal injector is available, inject a signal at the base of the first video amplifier. If the raster becomes modulated as shown in Picture 15-2, the video amplifier block is normal.

Otherwise, if the raster is not modulated, inject the signal at the base of the second video amplifier transistor (Q2). If the raster becomes modulated,



Picture 15-1

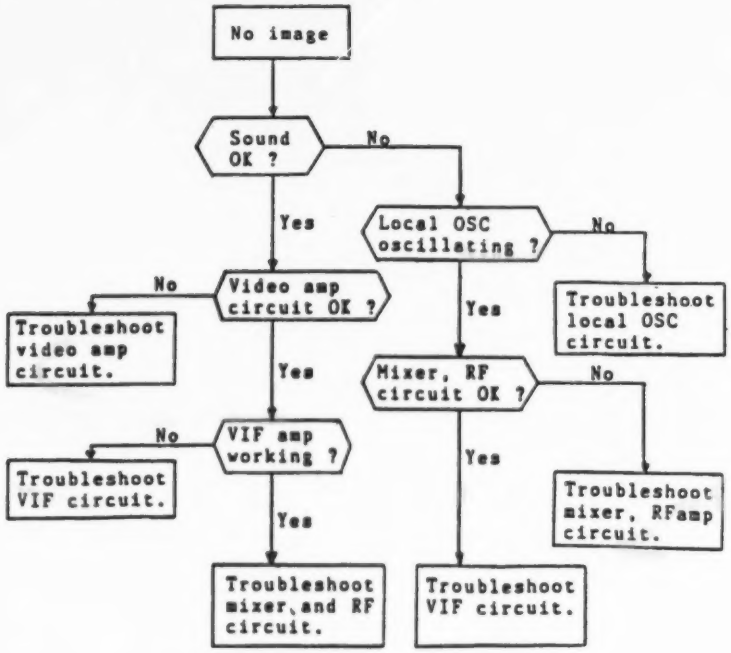


Fig. 15-1
Trouble-shooting flow chart for no image

the first video amplifier stage is defective. Otherwise, if the raster is still unmodulated, the trouble in most cases is in the second video amplifier stage.

After identifying the defective stage, find the defective component with the aid of a VOM. Do not remove a component from the PCB unless it is suspected to be defective after voltage and continuity tests. Refer to the diagram for the correct voltages at several points in the circuit.

Locating the defective amplifier stage with the aid of an oscilloscope is better. Picture 15-2 shows the correct wave-forms for the video amplifier circuit referred to above.

2 ***Trouble-shooting the VIF amplifier circuit***

Inject a VIF signal from an RF signal generator at the base of the transistors in the VIF amplifier circuit given in Fig. 15-5 starting from Q4 towards Q1. Set the output level of the signal generator at a low level to prevent overloading the VIF circuits. The raster will be modulated as shown in Picture 15-3 if the stage where the signal is injected is operating properly. If all the stages are operating properly, the modulated raster has more contrast if the signal is injected at the initial stages of the VIF circuits.

If a defective stage is found, pinpoint the defective component with the aid of a VOM. Refer to the circuit for the voltages at several points. Common troubles are defective transistor and open base or collector resistor.

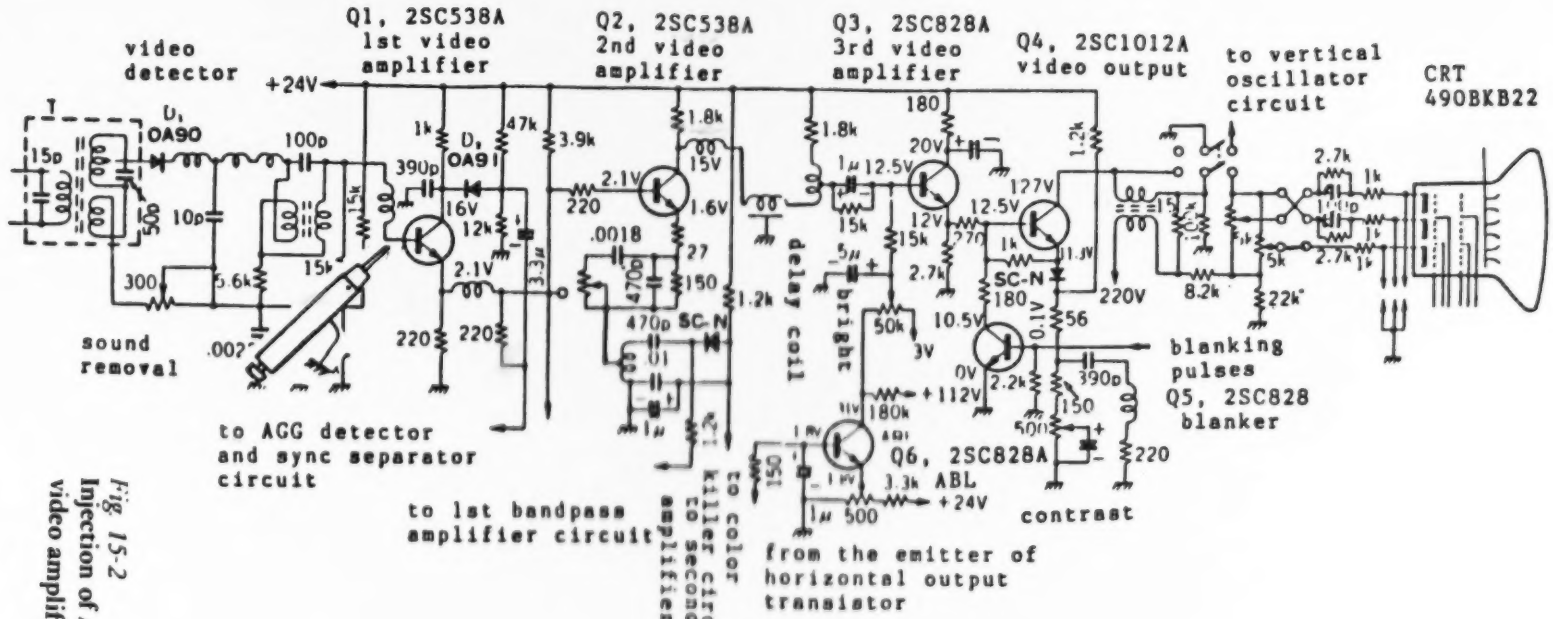


Fig. 15-2
Injection of AF signal into the video amplifier circuit

NO IMAGE 73

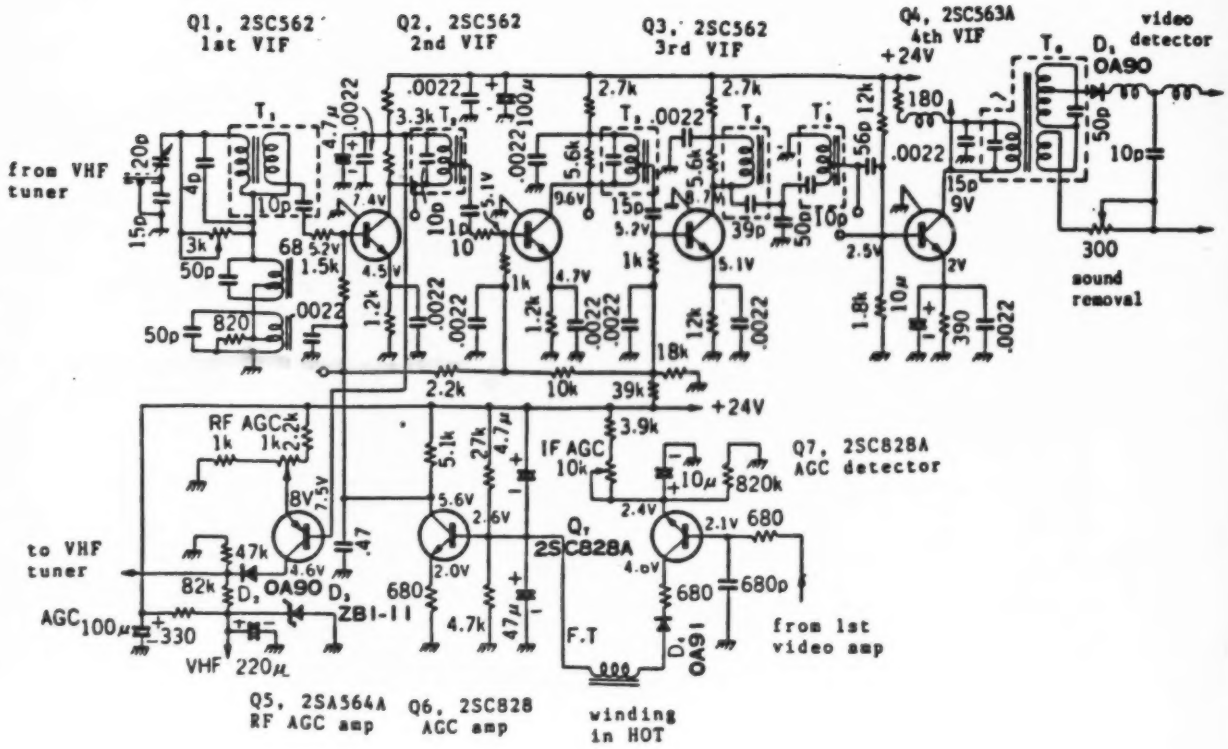
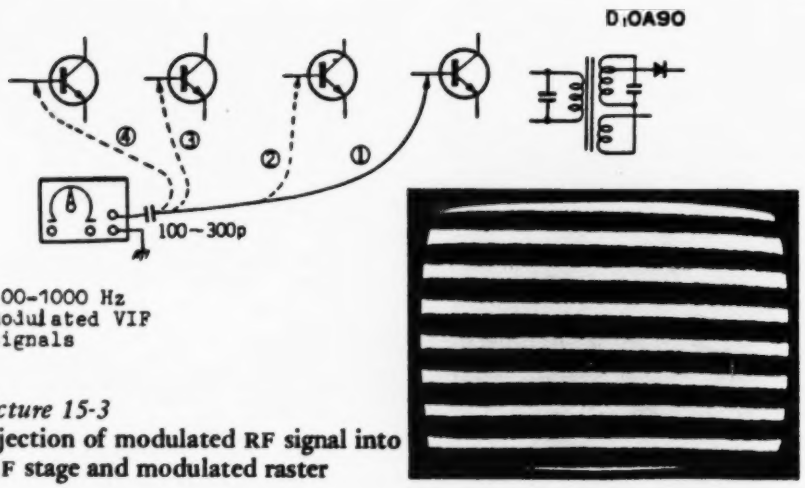


Fig 15-3
VIF and AGC circuit



Picture 15-3
Injection of modulated RF signal into VIF stage and modulated raster

Signals from a signal injector may also be used for signal injection in the VIF circuits. However, since the VIF circuits are high-frequency-tuned circuits, signals from a signal injector may not be as reliable as those from an RF signal generator.

3 ***Trouble-shooting the AGC circuit***

A defective AGC circuit may supply an excessive AGC voltage and decrease the gain of the VIF amplifier considerably. Thus, when the VIF amplifier circuit is operating properly, trouble-shoot the AGC circuit. The circuit in Fig. 15-3 also shows an AGC circuit.

Short the emitter and the collector of the AGC amplifier transistor (Q6) with a clip cord. If the picture or image appears, then the trouble is either in the AGC detector or in the AGC amplifier circuit. Use a VOM to identify the defective stage and component. Refer to the diagram for the proper voltage readings.

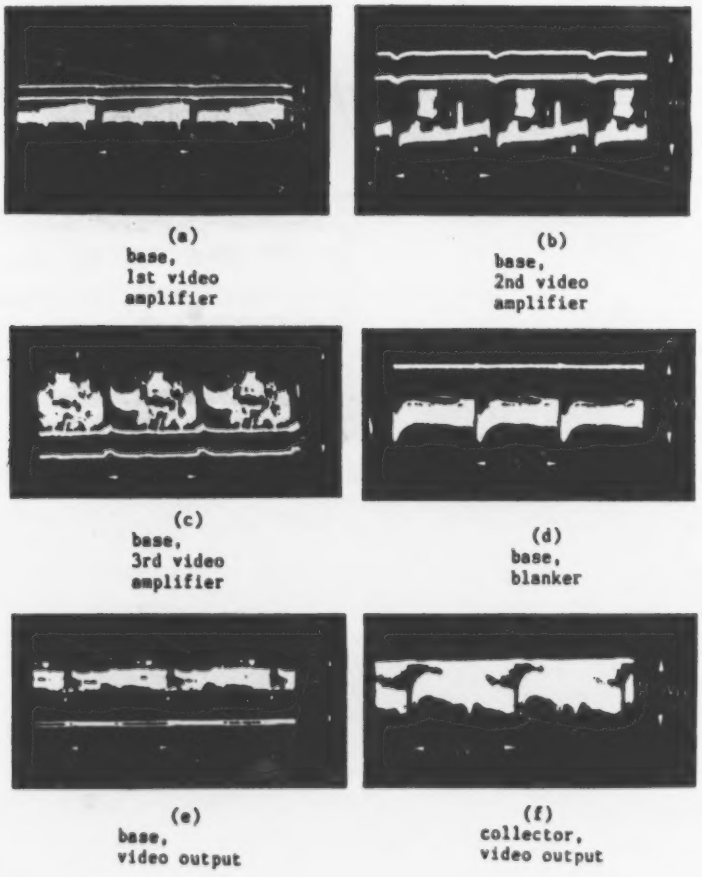
Notes

Referring to Fig. 15-3, note that the AGC voltage is also supplied to the tuner circuit. Thus, a trouble in the AGC circuit may affect the biasing of the tuner circuit and result in loss of image and sound.

A decrease in the gain of the tuner circuit due to an excessive AGC voltage can be detected by disconnecting the cathode of D2 from the circuit. If the image and sound come back, the trouble is in the RF AGC amplifier circuit.

4 ***Trouble-shooting the tuner circuit***

Observe the raster and the sound for a more effective trouble-shooting. If there is no image and sound, observe the raster. If it is snowy, the local oscillator may be defective. If the raster is plain without noise or snow, the mixer circuit may be defective. If the sound is present and a very noisy and barely visible image is



Picture 15-4
Normal wave-forms in video amplifier circuit

observed on the raster, the RF amplifier may be defective.

Start trouble-shooting the defective stage by measuring the voltages. It is hard to measure voltages inside the tuner. However, discrete components in a solid-state tuner are lesser than in vacuum-tube tuners, making it easier to measure voltages in a solid-state tuner. A tuner circuit is given in Fig. 15-4 with voltages at several points.

Technical memo

1 In circuits similar to Figs. 15-2 and 15-3, a trouble in the stages succeeding the second video amplifier stage will result in a dark raster or sometimes in a loss in the raster.

2 When the video amplifier circuit is defective, the image is generally lost. However, sometimes the colour subtraction signal from the colour demodulation and output circuit that is supplied to the CRT will produce a weak colour image on the screen.

For example, when the video amplifier is defective, a weak colour image

may appear on the screen when the colour control adjustment is set to maximum. However, the reproduced image is dark and poor in hue.

3 Check the oscillation of the local oscillator circuit by measuring the pin voltages of the oscillator transistor and compare them with the values indicated in the diagram.

Another and more practical way to confirm the oscillation of the oscillator is to touch the local oscillator coil while measuring the emitter voltage of the local oscillator translator. If the emitter voltage drops slightly, the circuit is oscillating. Observe the meter carefully, since the voltage drop is slight and may not be easily noticeable especially if the VOM is set at a high-voltage range.

b IC circuits

A trouble-shooting flow chart is given in Fig. 15-1. The hybrid VIF and video amplifier circuit given in Fig. 15-5 will be used for reference in this section. A hybrid circuit uses transistors and ICs.

1 *Trouble-shooting the video amplifier circuit*

Inject a signal at TP206 or TP205. A modulated raster (Picture 15-3) indicates an operative video amplifier circuit.

If a signal injector is not available, any audio signal or the AC filament voltage of the CRT can be used as a source signal. If the filament voltage will be used as a source, use a VOM with a capacitor connected in series to the positive probe to tap the signal from the filament circuit of the CRT. (See Fig. 15-7.) It is important to include the capacitor, since some receivers supply a large DC voltage

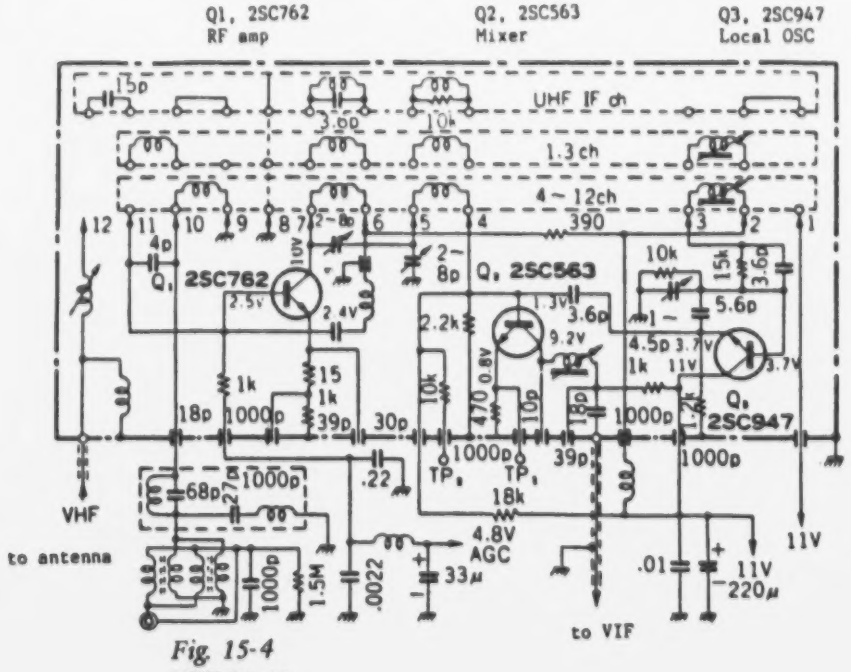


Fig. 15-4
VHF tuner

to the filament to hasten the warm-up time. The capacitor blocks the DC voltage that may damage the IC.

If the raster cannot be modulated by injecting a signal at TP205 or TP206, the circuit of IC202 is defective. Measure the pin voltages of the IC. Fig. 15-6 shows the internal schematic diagram of IC202 as well as the pin voltages and resistances relative to ground. Before measuring resistances, the power must be switched off first. If a voltage reading or resistance reading is incorrect, check the surrounding components. If all the surrounding components are confirmed to be in good condition, replace the IC with a new one.

The possible defective components are indicated with arrows in Fig. 15-5.

2 *Trouble-shooting the VIF amplifier circuit*

Trouble-shoot the VIF circuits only after confirming that the video amplifier circuit is not defective. It would be more reliable to use an RF generator when injecting a signal at the VIF stages. Before injecting a signal, set the output of the signal generator at a low level to prevent overloading the circuit. An effective way to trouble-shoot the VIF amplifier is to start from the last stage of the VIF amplifier circuit (TP203 or TP202 in Fig. 15-5) towards the initial stages of the VIF amplifier circuit. Referring to Fig. 15-5, start from TP203 or TP202, to TP201, to the base of Q202 and then to the base of Q201. The raster becomes modulated if the circuit where the signal is injected is operating properly. The contrast of the modulated raster is stronger when the signal is injected at the initial stages. Contrast of the raster increases as the signal is injected at the earlier stages. If the raster is not modulated when the signal is injected at the last stage, the circuit of IC201 is defective.

In this case, measure the pin voltages and resistances of the IC relative to ground and compare the values measured with the values indicated in the diagram or service manual. The correct values of the pin voltages and resistances for the IC circuit shown in Fig. 15-5 are given in Figs. 15-6 and 15-7. Always check the surrounding components before replacing the IC.

If a transistor stage is defective, measure voltages at several points and the resistances of the surrounding components to find the defective component. The circuit in Fig. 15-5 includes normal voltages at several points. Common troubles in a transistor circuit are defective transistor and open base resistor. Other most common defective components are indicated with arrows in Fig. 15-5.

Technical memo

1 Theoretically, a breakdown in the second video amplifier circuit will result in the loss of the image but not in the loss of the sound and raster. However, in most cases, when this circuit becomes defective, the raster is also lost.

2 It is hard to determine the condition of the IC by measuring the pin voltages alone. Even if the measured value is approximately equal to the correct one (+/- 0.5 V), the IC may be defective.

3 In trouble-shooting the IC circuit shown in Fig. 15-5, voltage measurements are not enough to locate the defective component.

For example, when R1 (connected across IC201, pin no. 8 and ground) is open, the image is lost. In this case, the voltage at pin no. 8 will be around 2.8 V. This value is very close to the normal value of 2.4 V. Thus, in this case, voltage measurements will not show an open R1. However, continuity and resistance measurements will show an open R1. If R1 is normal, the resistance at pin no. 1 is around 250 ohms. When R1 is open, the resistance increases to around 5 k ohms.

When trouble-shooting an IC circuit, always get a diagram. The IC should be replaced only after the surrounding components are confirmed to be in good condition.

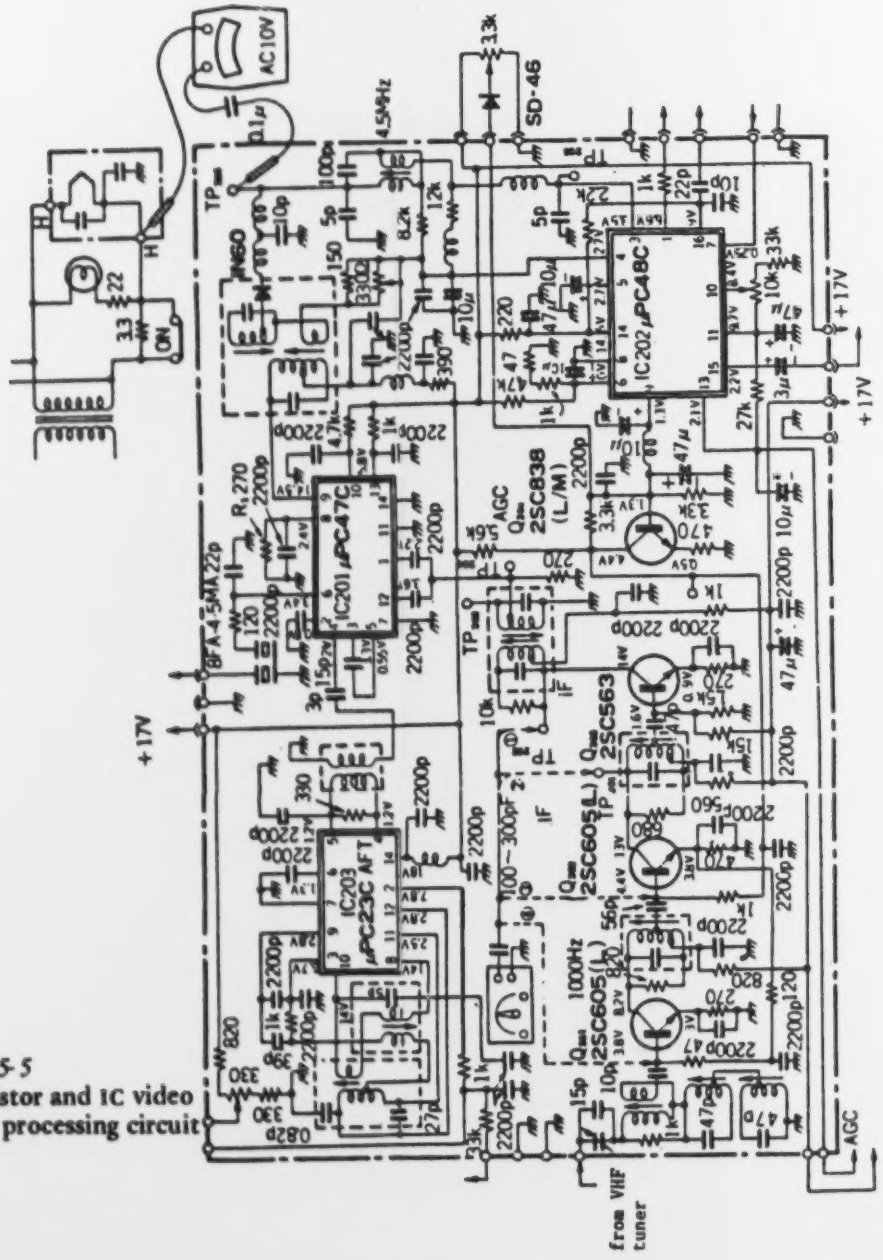


Fig. 15-5
Transistor and IC video signal processing circuit

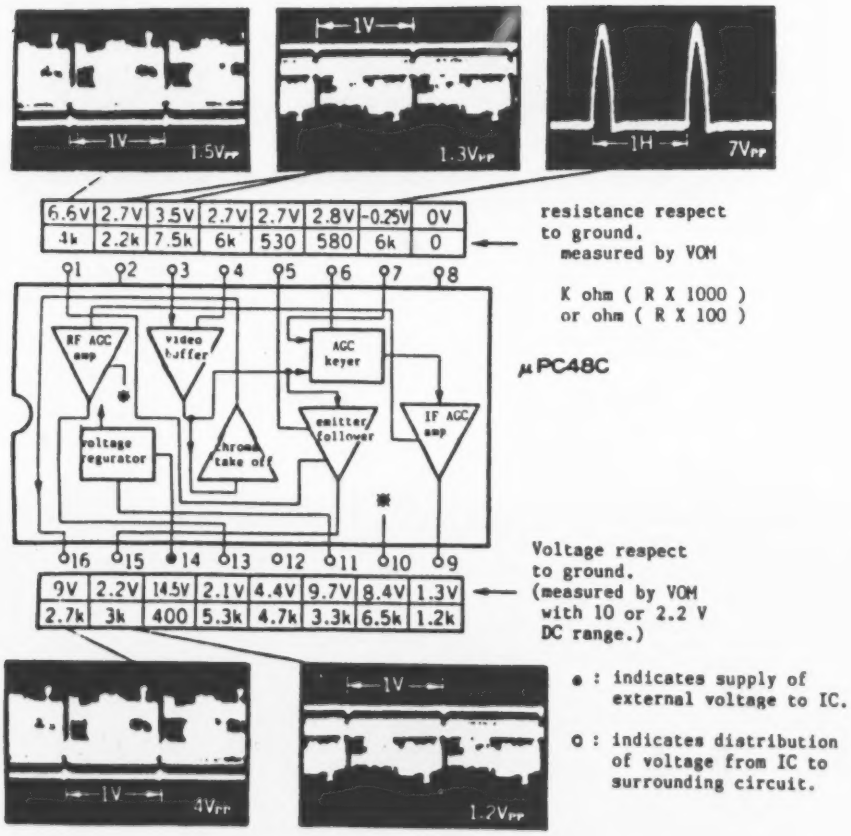
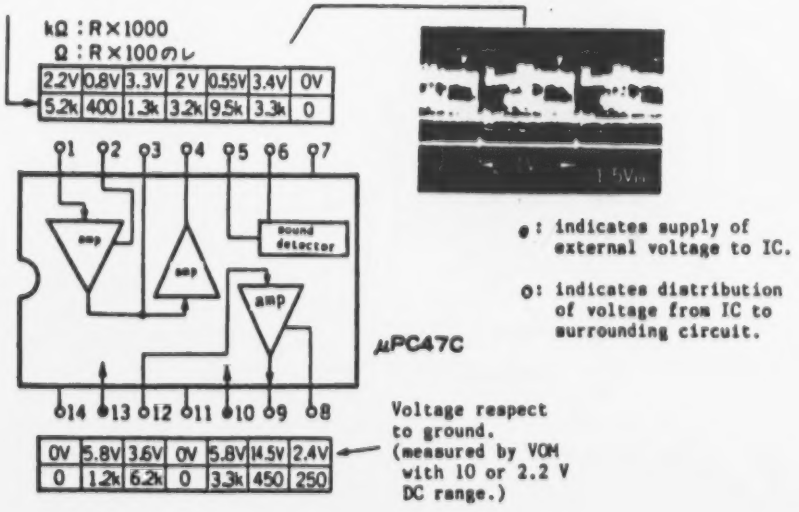

1V
1.5Vpp
1V
1.3Vpp
1H
7Vpp
6.6V 2.7V 3.5V 2.7V 2.7V 2.8V -0.25V 0V
4k 2.2k 7.5k 6k 530 580 6k 0
resistance respect to ground. measured by VOM
K ohm (R X 1000) or ohm (R X 100)
1 2 3 4 5 6 7 8
RF AGC amp
video buffer
AGC keyer
μPC48C
voltage regurator
chroma take off
emitter follower
IF AGC amp
16 15 14 13 12 11 10 9
9V 2.2V 14.5V 2.1V 4.4V 9.7V 8.4V 1.3V
2.7k 3k 400 5.3k 4.7k 3.3k 6.5k 1.2k
Voltage respect to ground. (measured by VOM with 10 or 2.2 V DC range.)
1V
4Vpp
1V
1.2Vpp
● : indicates supply of external voltage to IC.
○ : indicates distribution of voltage from IC to surrounding circuit.

Fig. 15-6
Normal voltage, resistance and wave-forms in IC 202

resistance respect to ground. measured by VOM

K ohm (R X 1000) or ohm (R X 100)

Fig. 15-7
Normal voltage, resistance and wave-forms in IC 201


kΩ : R×1000
Ω : R×100のレ
2.2V 0.8V 3.3V 2V 0.55V 3.4V 0V
5.2k 400 1.3k 3.2k 9.5k 3.3k 0
1 2 3 4 5 6 7
amp
amp
amp
sound detector
μPC47C
14 13 12 11 10 9 8
0V 5.8V 3.6V 0V 5.8V 14.5V 2.4V
0 1.2k 6.2k 0 3.3k 450 250
Voltage respect to ground. (measured by VOM with 10 or 2.2 V DC range.)
● : indicates supply of external voltage to IC.
○ : indicates distribution of voltage from IC to surrounding circuit.

16 Weak contrast

This symptom can be divided into two cases. One is accompanied with too much noise or snow, the other is not (simply weak in contrast).

Cause: Weak contrast and snowy picture are caused by a trouble in the antenna or in the RF amplifier circuit.

Plain weak contrast is caused by a trouble between the mixer and the video amplifier circuit inclusive.

TROUBLE-SHOOTING PROCEDURE

Check whether the TV set has a weak contrast reception in all channels. If you observe weak contrast in only one station, check the faulty contact in the tuner.

If there is weak contrast in all channels, adjust the AGC control (both RF and AGC) first. If the symptom cannot be eliminated, check if the symptom is accompanied with snow or not.

If the picture is snowy, check for an open circuit in the antenna feeder cable or in the RF amplifier circuit.

If the picture is not snowy, observe the output signal of the video detector with an oscilloscope, as shown in Fig. 16-1. Normally, a signal of around 1.5 V p-p to 2 V p-p can be observed. If the strength of the signal is very low, check the mixer, VIF, video detector and the AGC circuits. If the output voltage of the video detector is normal, check the video amplifier circuit. Refer to the flow chart shown in Fig. 16-2.

1 ***Trouble-shooting the antenna circuit***

An open or broken feeder cable connecting the external antenna and the receiver will result in weak contrast and noisy picture. The condition of the feeder cable can be easily detected by visual inspection or by a continuity test.

In coastal areas, granules of salt adhering to the feeder cable will decrease the strength of the signal transmitted to the receiver. If this is suspected to be causing the symptom, replace the feeder cable at least once a year or replace it with a coaxial cable.

2 ***Identifying a loose contact in the tuner***

Tune the receiver to a station with weak contrast, then tap or slightly move ("jiggle") the tuner knob. If the contrast varies while doing so, then a loose contact in the tuner is confirmed.

In case the extent of the damage in the contacts of the tuner is minimal, a contact cleaner oil can be used to revive the contact points. Do not apply too much contact cleaner oil, as it may gather dust and worsen the condition later. It may also be hazardous to the tuner circuit. After applying the contact cleaner, wipe off the excessive oil. If the contacts are badly damaged and cannot be remedied by a contact cleaner, the only alternative is to replace the tuner.

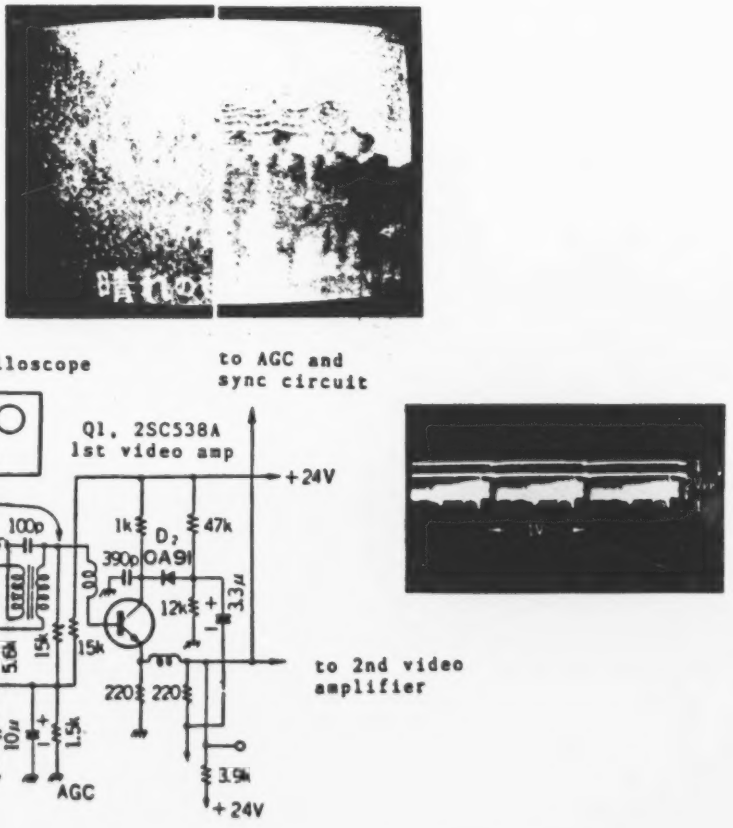


Fig. 16-1
Observation of output signal at the output of video detector

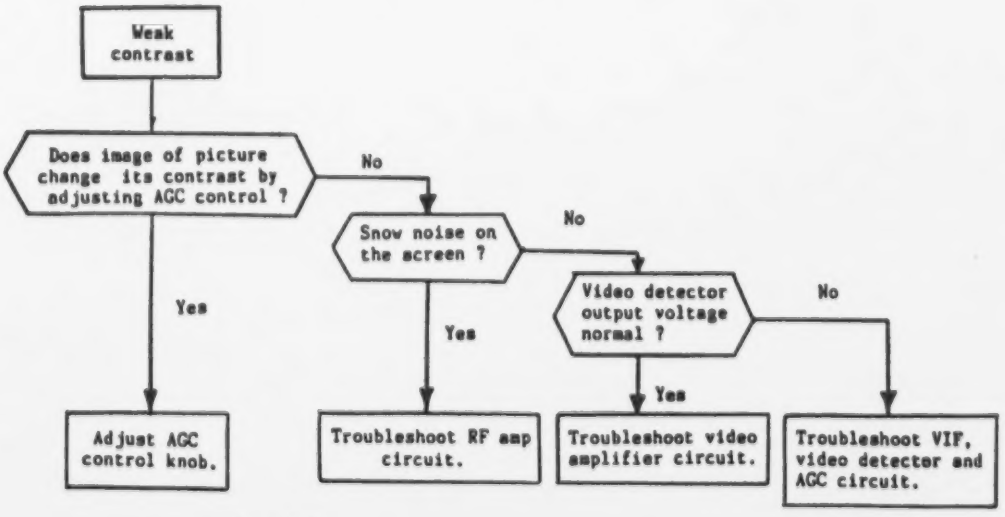


Fig. 16-2
Trouble-shooting flow chart of weak contrast

3 *Trouble-shooting the RF amplifier and the mixer circuits*

Measure the transistor voltages with a VOM to determine the operation of the circuit in Fig. 16-3. It is much easier to measure the voltage in solid-state tuners than that in vacuum-tube VHF tuners.

A defective transistor and an open resistor are common troubles within the tuner. Therefore, check the condition of the above components with priority. The normal voltages and the most likely defective components are also indicated in the figure.

4 *Trouble-shooting the VIF amplifier circuit*

Measure the transistor voltages of the VIF amplifier circuit in Fig. 16-4 to locate an aged stage with a decreased gain. The normal voltages and the possible defective components are also indicated.

5 *Trouble-shooting the AGC circuit*

Even when the FR and VIF amplifier circuits are operating normally, a trouble in the AGC circuit will reduce their gain and therefore cause the symptom.

Measure the collector voltage of the AGC amplifier transistor (Q6 in Fig. 16-4) and check the AGC line going to the tuner. If the voltage measured is rather high, the trouble is suspected to be in the AGC circuit. Defective transistors (Q5, Q6, Q7), open resistors (R1, R2, R3, R4, R5) and leaky capacitors (C1, C2) are the most likely troubles.

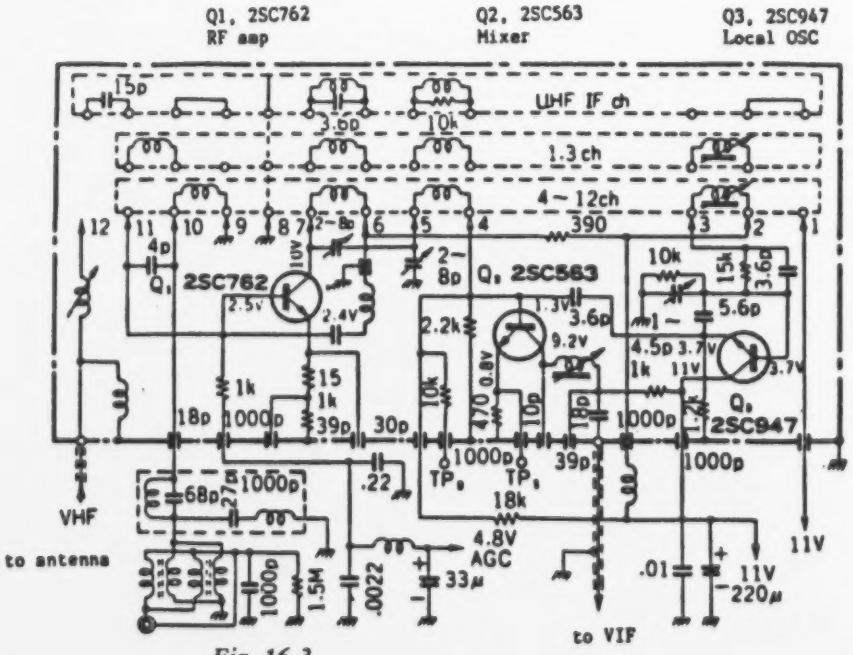


Fig. 16-3
VHF tuner circuit

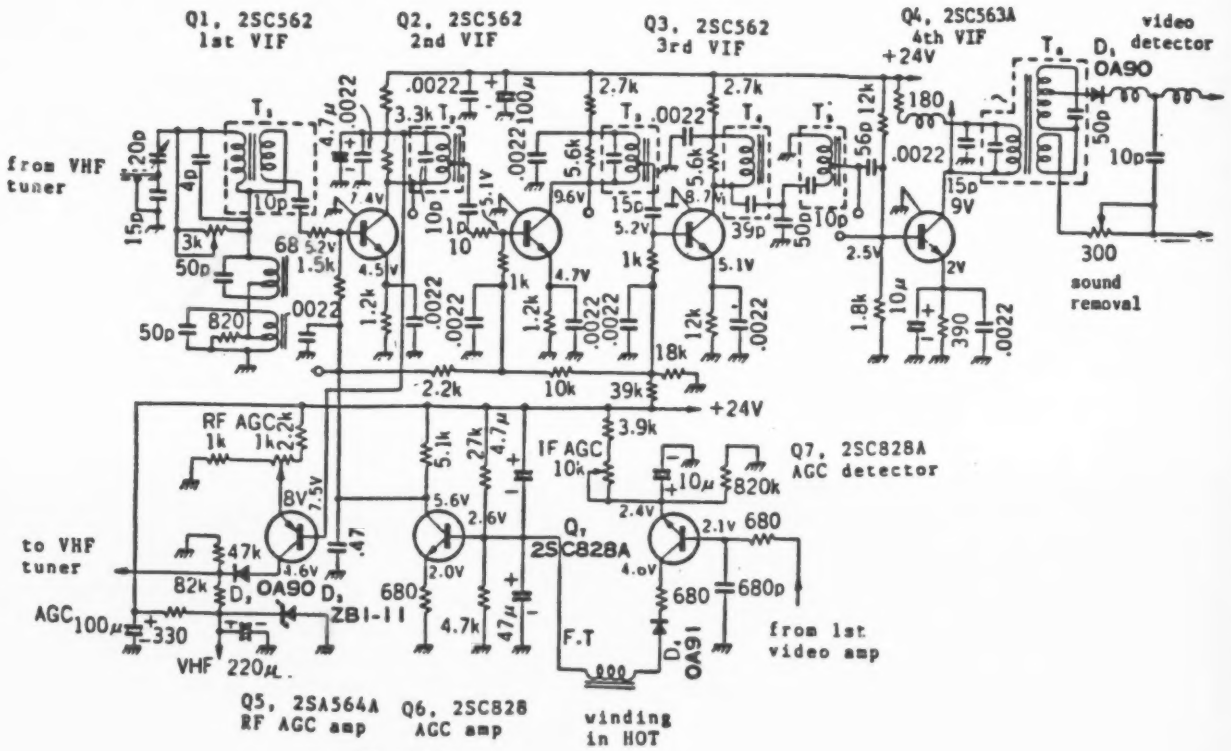


Fig. 16-4
VIF and AGC circuit

6 ***Trouble-shooting the video amplifier circuit***

The video amplifier circuit amplifies the video detector output (1.6 V p-p to 2 V p-p) to around 100 to 120 V p-p. Trace the video signal with an oscilloscope to check the amplification of the video-detector circuit. If you find a defective stage, use a VOM to isolate the defective component. Usually, a defective first video amplifier circuit results in a weak contrast picture.

Reference

When the CRT emission becomes weak, the reproduced picture will have a weak contrast. Besides weak contrast, other symptoms such as a longer warm-up time for the CRT, a dark picture, a negative picture (in black-and-white CRTs), and a disrupted white-balance scale can be observed.

If a channel has a noisy and weak contrast reception and the tuner has no loose contact, the receiver may be outside the effective service radius of the transmitter of that particular station.

17 No reception in a particular channel

This symptom is characterised by the reception of some TV broadcast stations but not all.

Cause: This symptom is caused by either a loose contact in the tuner or a shift in the local oscillation frequency for that particular channel.

TROUBLE-SHOOTING PROCEDURE

Tune the receiver to the station that cannot be received. "Jiggle" or move the channel selector slightly. While doing so, observe the screen. If reception occurs in doing so, the trouble lies in the defective tuner contacts. If the damage of the tuner contacts is not critical, clean the contacts with a contact cleaner. A contact cleaner usually comes in spray form. Wipe off the excess contact cleaner oil, since this will accumulate dust and may worsen the situation.

If the tuner has no loose contact, the trouble may be a shifting of the local oscillator's frequency for that channel. Adjust the fine-tuning knob until that particular broadcast channel is received. Sometimes you need to adjust the coil for that particular station in the tuner (for turret type).

Note

When the reception of a station is lost, before doing any trouble-shooting make sure that the station did not stop broadcasting.

18 Negative contrast

This symptom is characterised by a negative image with an unstable reception. This symptom is commonly observed in areas near TV transmitter stations. The symptom occurs when the RF or the VIF circuits are overloaded.

Cause: A misadjustment or a breakdown in the AGC circuit usually causes this symptom.

TROUBLE-SHOOTING PROCEDURE

Readjust the AGC control first. If the symptom cannot be eliminated, measure the AGC voltage at nodes A and B in the tuner and the VIF circuit shown in Fig. 18-1. If the voltage is considerably lower than what is indicated in the diagram, check the AGC transistors (Q6, Q7) and for possible open resistors (R1, R2, R3) and shorted capacitors (C1, C2).

Reference

The gain of a transistor is related to the magnitude of the collector current. The AGC circuit makes use of this characteristic of a transistor to control the gain of a transistor amplifier stage. There are two types of AGC circuits used: the reverse

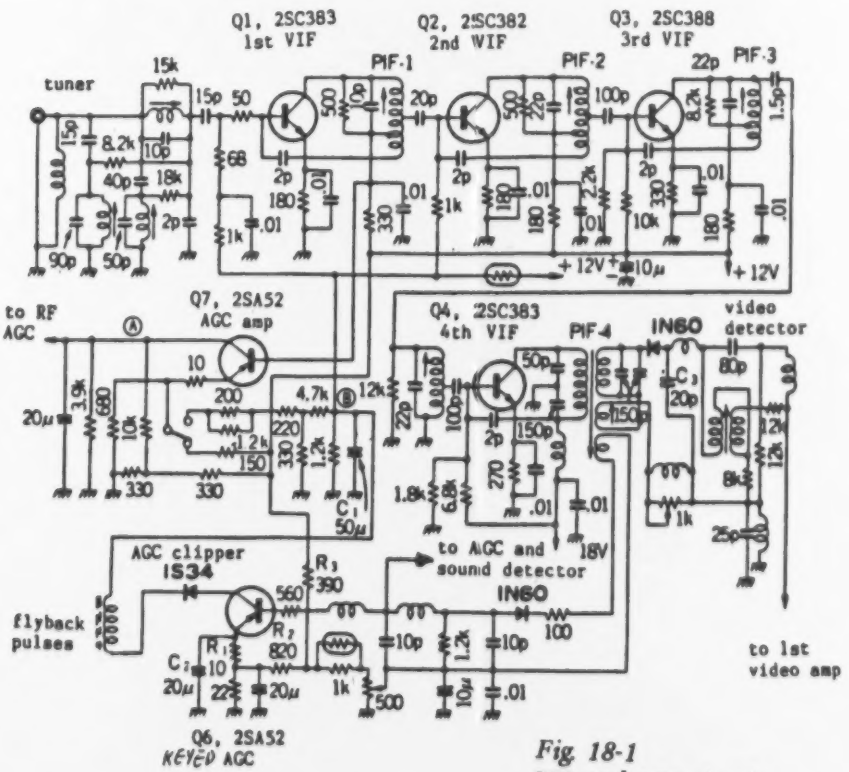


Fig. 18-1
VIF and AGC circuit

Picture 18-1

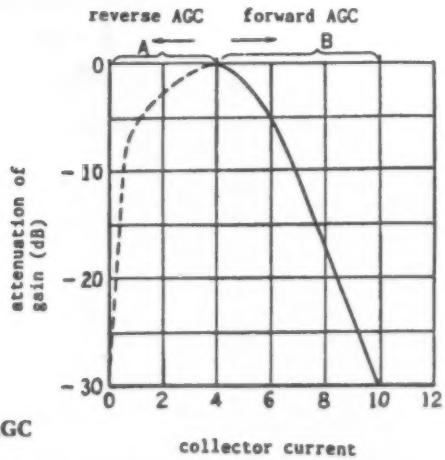


Fig. 18-2
Foward and reverse AGC

AGC and the forward AGC. In the reverse AGC, the gain of the transistor is decreased by reducing the forward-bias at the base or decreasing the collector current towards cut-off. (See the dashed curve in Fig. 18-2.) In the forward AGC, the gain of the transistor is decreased by increasing the collector current or increasing the forward-bias at the base. (See the solid curve in Fig. 18-2.) Forward AGC is more commonly used in the modern TV receiver sets.

In the forward AGC circuit shown in Fig. 18-2, the base voltage of the RF amplifier and VIF amplifier transistors is increased by the AGC voltage when the level of the input signal increases. This increases the collector current and reduces the gain of the transistors. Therefore, the level of the output of the RF and VIF circuits is maintained.

If the AGC circuit breaks down, the base voltage of the RF and VIF amplifier transistors decreases and the gain of these transistors increases. This results in overloading of the RF and VIF circuits.

Thus, when this symptom is encountered, find out what caused the decrease in the base voltage of the RF and VIF amplifier transistors.

19 Image interference from other stations

This symptom is characterised by image disturbances. The image of the desired station seems to be dubbed by another image from a different station. This symptom is also usually called the windshield-wiper distortion because a black vertical bar (horizontal blanking signal) moves horizontally across the screen like the wiper of a car.

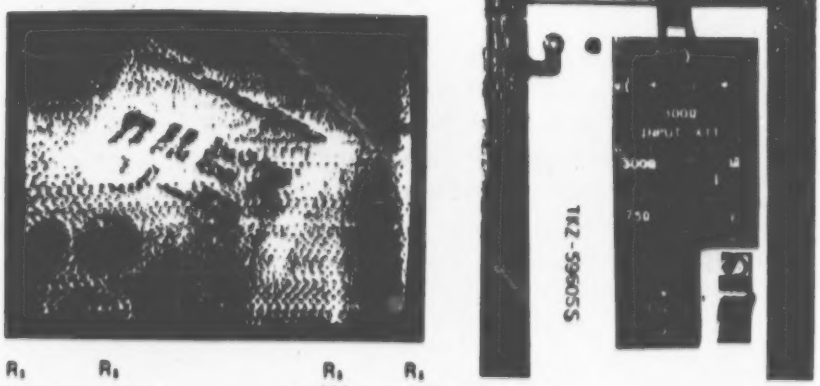
Cause: This symptom is caused by the overloading or cross-modulation of the RF amplifier circuit. This usually happens in receivers located near a TV transmitter.

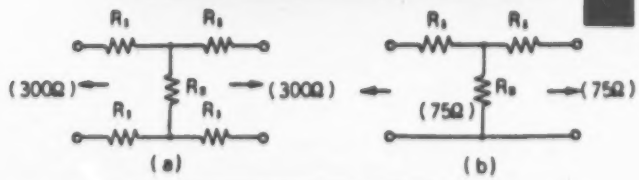
Countermeasure

Adjust the AGC control first. If the symptom cannot be eliminated, use an attenuator pad to reduce the strength of the signals coupled to the tuner. An example of a simple resistor attenuator network is shown in Fig. 19-1.

Technical memo

In community antenna systems (used in condominiums and hotels) and cable TV systems, if the strength of the RF signals of different channels is not uniform at the input of the booster amplifier, cross-modulation is produced in the circuit and will affect the receivers connected to it.





(dB)	(a)		(b)	
	R_1 (Ω)	R_2 (Ω)	R_1 (Ω)	R_2 (Ω)
20	120	60	60	15
10	80	210	40	50
6	50	400	25	100

Fig. 19-1
Attenuation chart

20 White dots on the screen

This symptom is characterised by the appearance of the intermittent white dots scattered on the screen. The reception, however, is normal.

Cause: This symptom is caused by noises from ignition coils of automotive engines or from high-tension power lines, or by a nearby receiver with a defective high-voltage circuit.

TROUBLE-SHOOTING PROCEDURE

If a defective nearby TV receiver is suspected to be causing the symptom, locate the defective receiver and shut it off. If the symptom disappears, trouble-shoot the defective receiver causing the symptom. In most cases, a high-voltage leak causes the symptom to nearby receivers. A high-voltage leak is usually accompanied with a high-pitched hissing sound and a pungent ozone smell.

Technical memo

A high-voltage leak usually occurs when the anode cap or the high-voltage cable has a crack or when the horizontal output transformer (HOT) is dusty. When a high-voltage leak is observed, clean the components handling high voltages. However, before doing so, make sure that the power is off and stored charge in the anode of the cathode-ray tube is discharged to avoid possible dangerous electric shocks. If the high-voltage leak cannot be prevented by cleaning the high-voltage components, check the anode cap and the high-voltage cable for cracks. Replace them if necessary. Also, check the HOT for a partial open circuit.

The area affected by a colour receiver with a high-voltage leak is larger (i.e. 50 m radius) than the area affected by a black-and-white receiver with a high-voltage leak because the high voltage of colour receivers is around 24 kV; that of a black-and-white receiver is around 7 kV.

21 No colour

This symptom is characterised by a monochrome picture even during colour reception. There are three cases of this symptom: 1) colour loss in all channels, 2) colour loss in a particular channel and 3) intermittent colour loss.

Cause

1 ***No colour in all channels.*** A trouble in any of the following circuits may cause the symptom: bandpass amplifier, ACC, colour killer, 3.58 MHz oscillator, 3.58 MHz output, burst gate and burst amplifier circuits.

2 ***No colour in some or in a particular channel.*** This symptom is caused by a misadjustment in the fine-tuning circuit (shift in the local oscillator frequency) or a loose contact in the channel selector switch.

3 ***Intermittent colour loss.*** This is caused by a loose contact in the channel selector, mismatch between the antenna and the receiver or an intermittent operation of the 3.58 MHz oscillator.

TROUBLE-SHOOTING PROCEDURE

a **Solid-state circuits**

The trouble-shooting procedure for colour loss in all channels will be discussed. Nevertheless, it may serve as reference for trouble-shooting the receiver for the other cases of colour loss.

Note that for this symptom, the defective component may be in any of the numerous possible defective circuits. Thus, for an efficient and prompt trouble-shooting, observe the symptom carefully. The exact method of trouble-shooting a receiver for this kind of symptom varies with the type of circuit used in the chroma or colour circuits. The trouble-shooting details that will be given are for circuits similar to the one given in Fig. 21-2. However, the trouble-shooting flow chart shown in Fig. 21-1 may be used as reference in trouble-shooting other types of circuits.

First, adjust the fine-tuning control with the colour intensity set at maximum and the colour killer set at minimum. If you cannot get the colour, trouble-shoot the colour circuits.

Short the collector and the emitter of the ACC transistor (Q2) in Fig. 21-2. If the colour appears, the ACC circuit is defective. Otherwise, if you cannot regain the colour, disconnect the short across the collector and the emitter of the ACC transistor and ground the emitter of the second bandpass transistor (Q3). After doing so, adjust the colour killer control. If you cannot get the colour, the trouble may be in the bandpass amplifier circuit. Otherwise, if you recover a normal colour, the colour killer circuit is defective. But if the brighter parts of the picture have a weak tint of bluish green, the 3.58 MHz oscillator or the 3.58 MHz output circuit may be defective.

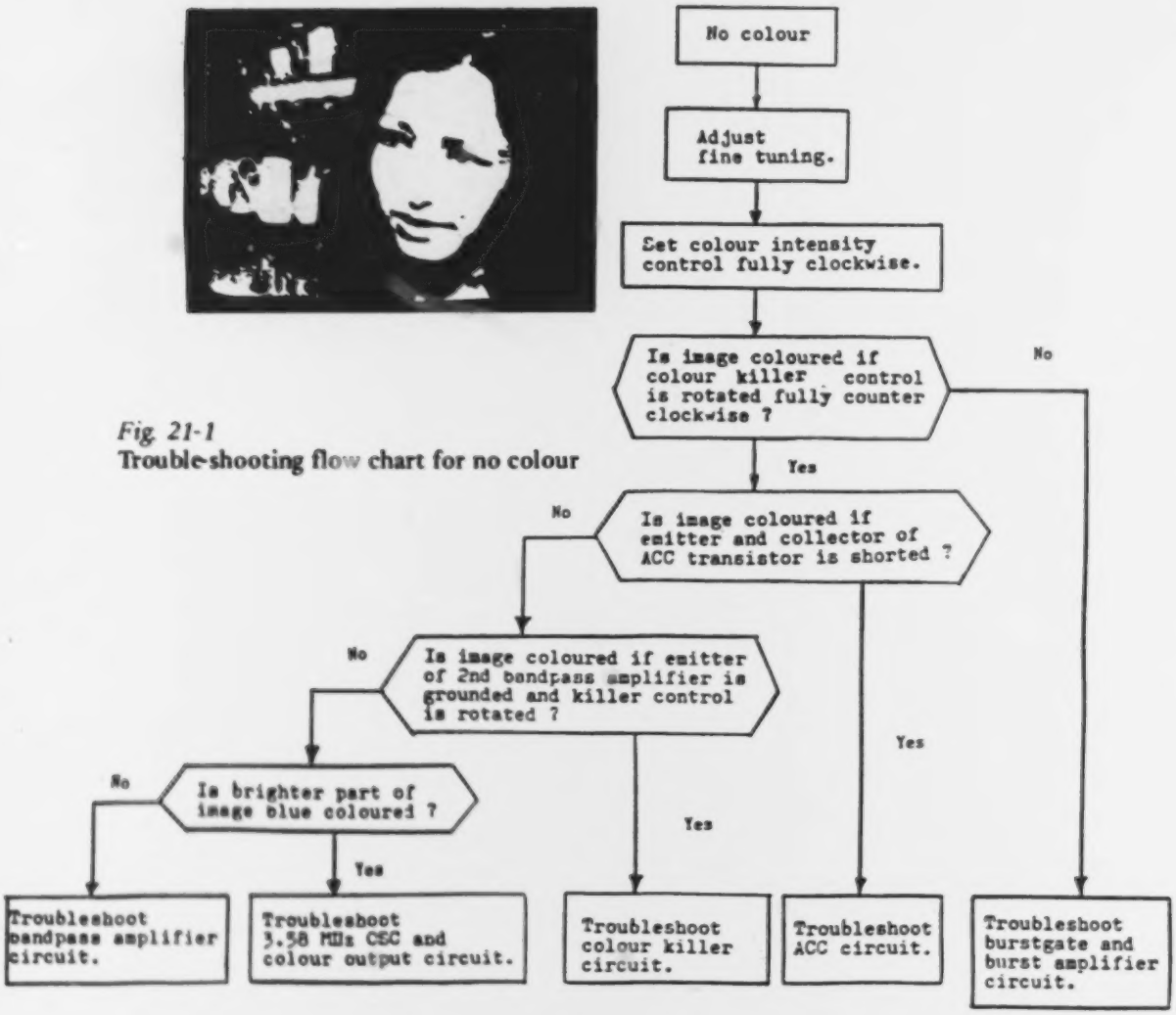

No colour
Adjust fine tuning.
Set colour intensity control fully clockwise.
Is image coloured if colour killer control is rotated fully counter clockwise ?
No
Yes
Is image coloured if emitter and collector of ACC transistor is shorted ?
No
Yes
Is image coloured if emitter of 2nd bandpass amplifier is grounded and killer control is rotated ?
No
Yes
Is brighter part of image blue coloured ?
No
Yes
Troubleshoot bandpass amplifier circuit.
Troubleshoot 3.58 MHz CSC and colour output circuit.
Troubleshoot colour killer circuit.
Troubleshoot ACC circuit.
Troubleshoot burstgate and burst amplifier circuit.

Fig. 21-1
Trouble-shooting flow chart for no colour

1 ***Trouble-shooting the bandpass amplifier circuit***

The best way to locate a defective component in this circuit is through voltage measurements, signal injection and signal tracing.

Measure the voltages of the transistors in the bandpass amplifier accurately. If there is any appreciable difference between the measured values and the values indicated in the diagram, check the components in the bandpass amplifier circuit. If a synchroscope (oscilloscope with trigger functions) with a sensitivity of up to 15 MHz is available, trace the processing of the chroma signal starting from the base and collector of the first bandpass amplifier and then to the base and collector of the second bandpass amplifier transistor. If this circuits are functioning properly, the wave-forms shown in Picture 21-1 can be observed. If you see an incorrect wave-form at a certain stage, trouble-shoot the preceding stage.

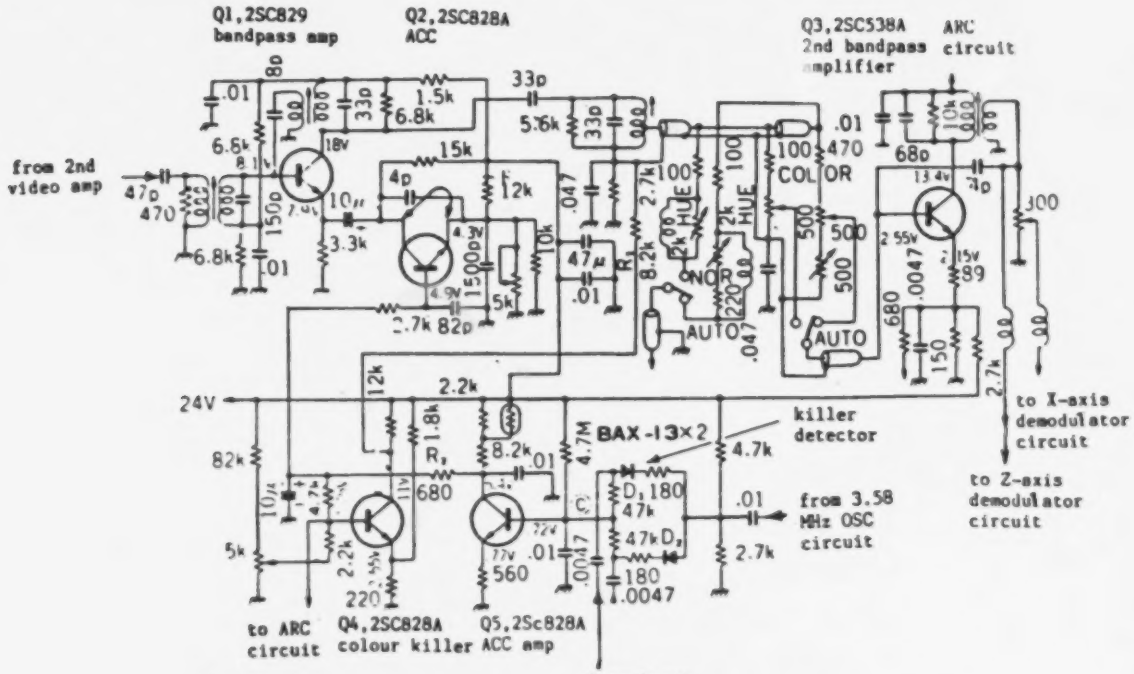
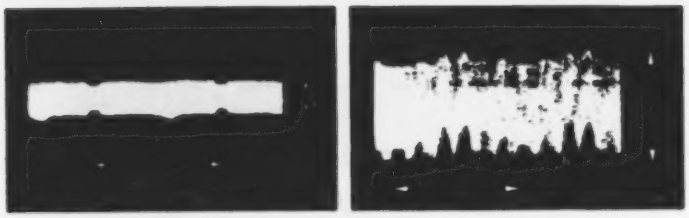


Fig. 21-2
Bandpass amplifier circuit

(a) base, 1st bandpass Tr.

(b) collector, 1st bandpass Tr.



(c) base, 2nd bandpass Tr.

(d) collector, 2nd bandpass Tr.

Picture 21-1
Normal wave-forms in bandpass circuit

2 ***Trouble-shooting the ACC and the colour killer circuits***

Check the transistor voltages with a VOM. If you get an incorrect reading, pinpoint the defective component with the aid of a VOM. A simple method in checking the condition of the colour killer transistor is to measure the emitter voltage when the base is shorted to the emitter and when it is not. The transistor is assumed to be in good condition if the emitter voltage is slightly lower when the base is shorted to the emitter. This method in checking the colour killer transistor is to be done only during black-and-white transmission.

3 ***Trouble-shooting the 3.58 MHz oscillator circuit***

A 3.58 MHz oscillator circuit is shown in Fig. 21-3. Check if the oscillator transistor (Q5) is oscillating by observing the wave-form at the collector. If the transistor is oscillating, check the output wave-form of the 3.58 MHz output transistor (Q3), since a trouble in this circuit may also cause the symptom. The correct wave-forms for this circuit are shown in Picture 21-2.

A trouble in the phase detector and DC amplifier circuits may disable the operation of the 3.58 MHz oscillator circuit. Thus, for an effective trouble-shooting, the relation between the circuits and how they affect each other should be known.

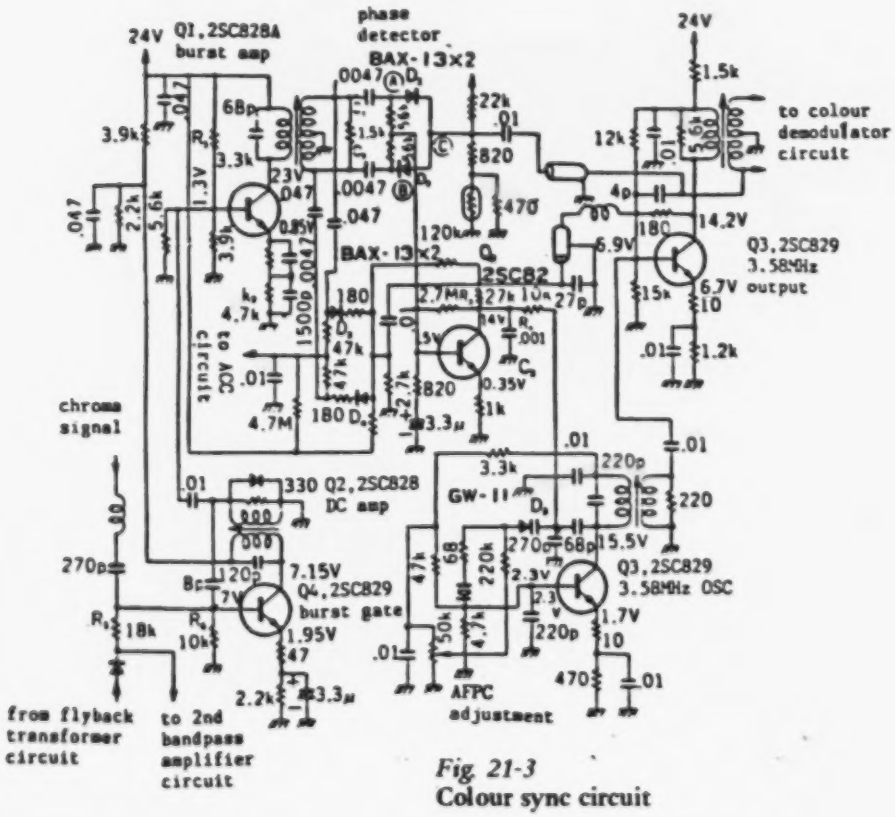


Fig. 21-3
Colour sync circuit

4 ***Trouble-shooting the burst gate and burst amplifier***

If you get unsynchronised colour when the colour killer control is set to minimum, the trouble often is either in the burst gate or in the burst amplifier circuit.

Measure the transistor voltages (Q1 and Q4) in Fig. 21-3 to identify the defective stage. After identifying the defective stage, pinpoint the defective component with the aid of a VOM. The normal voltages at several points in the circuit in Fig. 21-3, so with the common defective components, are indicated.

Technical memo

1 Some receivers use the type of colour circuit or a similar circuit given in Fig. 21-5. A trouble-shooting flow chart for this circuit is given in Fig. 21-4.

Before trouble-shooting the circuit, set the colour intensity to maximum first. If you get a weak tint of cyan or magenta, trouble-shoot the second carrier amplifier circuit.

Otherwise, if no colour can be recovered, short node A to node B in the colour killer circuit. If the symptom remains, the ACC circuit or the first or second bandpass amplifier may be defective. Otherwise, if a normal colour is re-

Picture 21-3

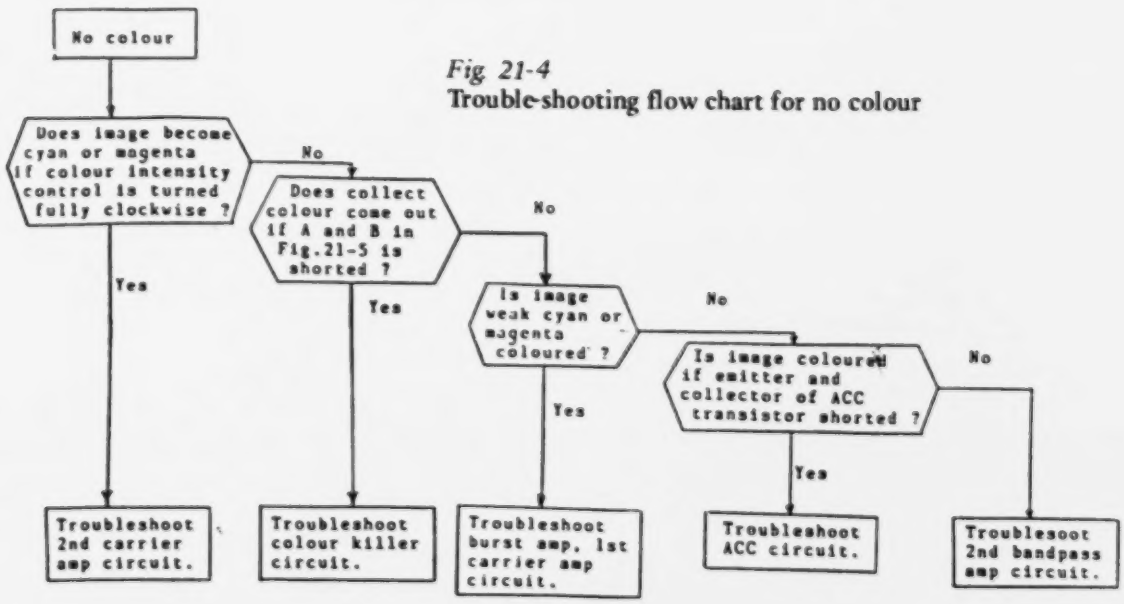

No colour
Does image become cyan or magenta if colour intensity control is turned fully clockwise ?
No
Does collect colour come out if A and B in Fig.21-5 is shorted ?
No
Is image weak cyan or magenta coloured ?
No
Is image coloured if emitter and collector of ACC transistor shorted ?
No
Yes
Yes
Yes
Yes
Troubleshoot 2nd carrier amp circuit.
Troubleshoot colour killer circuit.
Troubleshoot burst amp, 1st carrier amp circuit.
Troubleshoot ACC circuit.
Troublesoot 2nd bandpass amp circuit.

Fig. 21-4
Trouble-shooting flow chart for no colour

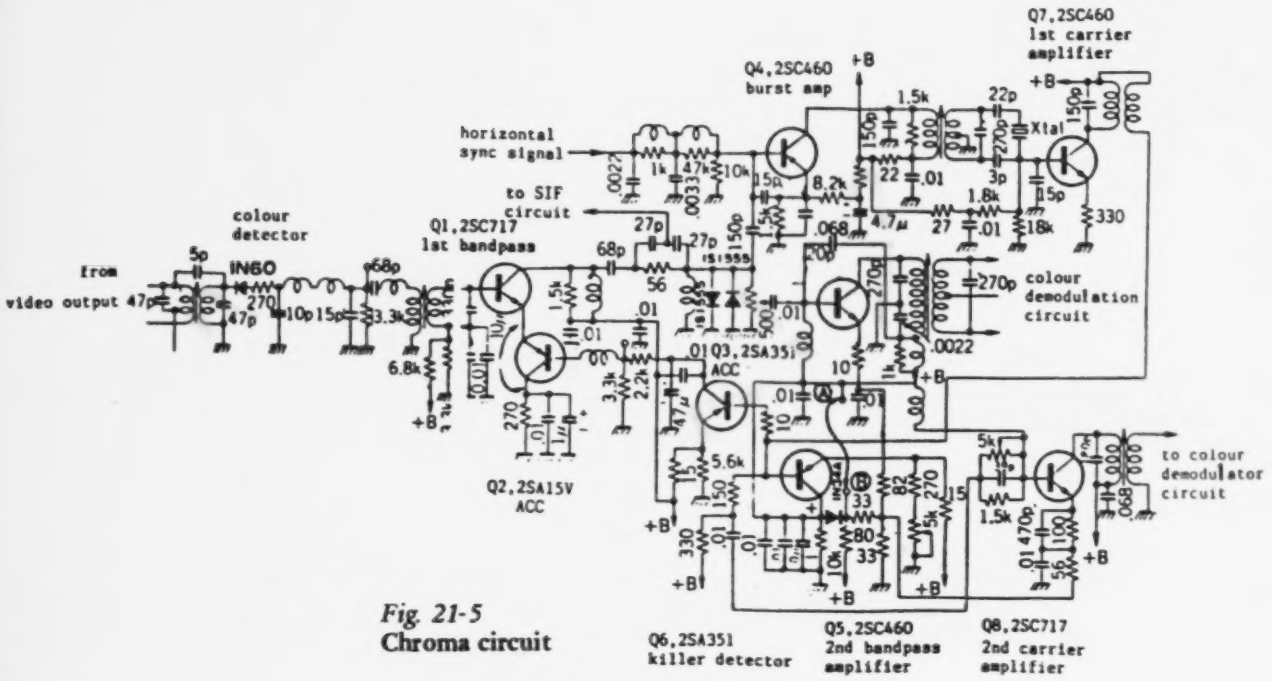


Fig. 21-5
Chroma circuit

covered after shorting these nodes, the colour killer circuit is defective. However, if the colour recovered has a tint of cyan or magenta, the burst amplifier or the first carrier amplifier circuit may be defective.

2 The colour sync circuit in Fig. 21-5 is a ringing type. Thus, the 3.58 MHz oscillator wave-form cannot be observed at the output of the second carrier amplifier circuit during black-and-white reception.

To check the condition of the circuit, observe the wave-form at the output during colour reception. Trace the signal by observing the wave-form at the base and at the collector of the burst amplifier transistor, then at the base of the first and second carrier amplifier transistors.

b **IC circuits**

An example of a chroma section IC circuit is shown in Fig. 21-6. A defective bandpass amplifier, ACC, colour killer, burst amplifier or 3.58 MHz oscillator circuits (all of which are part of IC IC701/uPC29C), and in the 3.58 MHz amplifier circuit will result in colour loss.

First, observe the wave-forms at TP701 and TP706 during colour transmission. The correct wave-forms are shown in Pictures 21-3 and 21-4, respectively. If the proper signal is present at TP701 but not at TP706, check the surrounding components of IC701.

If you see no signal at TP701 and TP706, observe the wave-form at the base of the 3.58 MHz amplifier transistor (Q701). The correct wave-form is shown in Picture 21-4. If the signal is not present, check the circuit from the

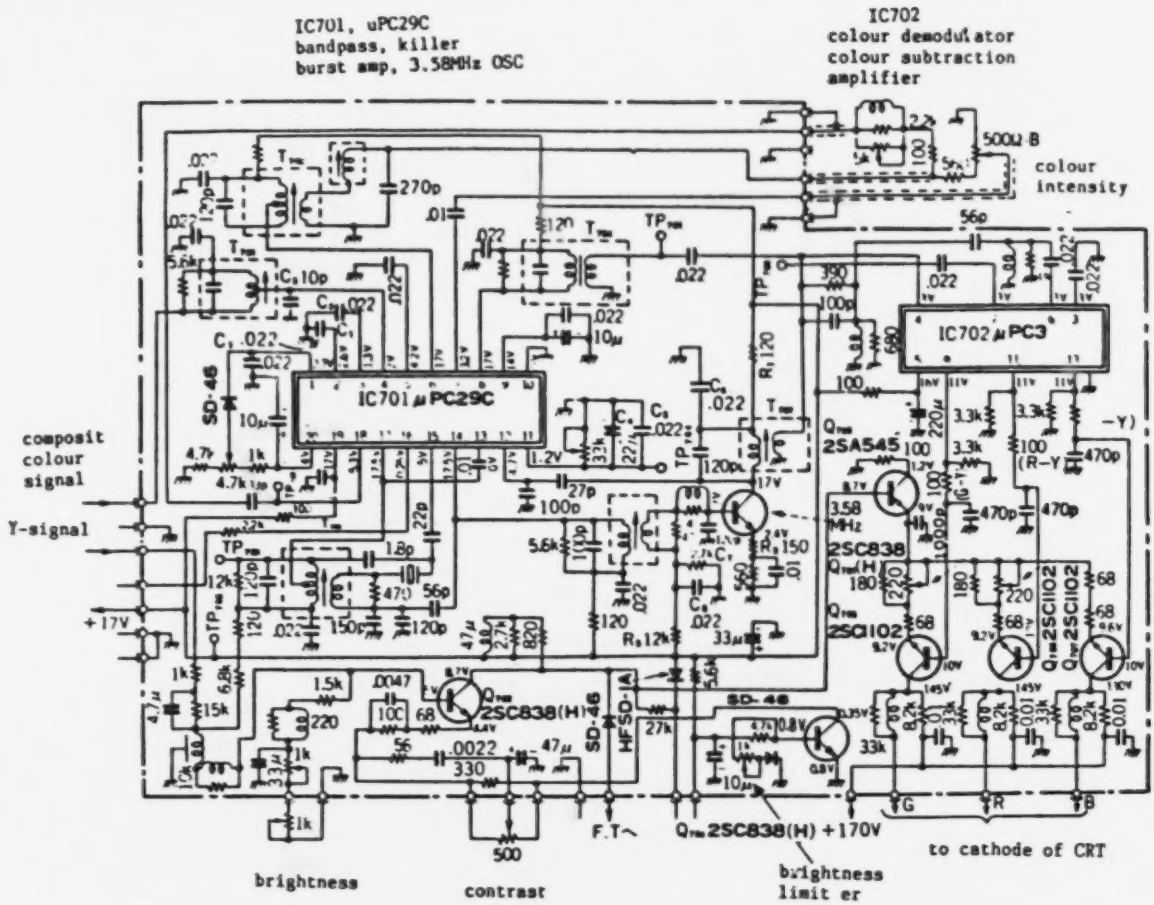
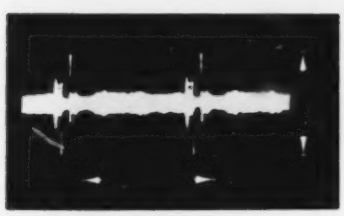
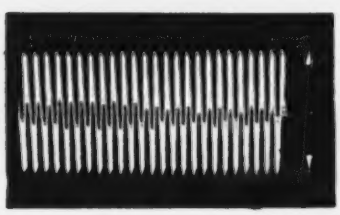


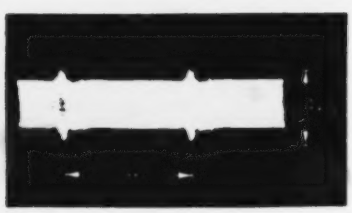
Fig. 21-6
IC chroma circuit



Picture 21-2
Normal wave-forms at 03



Normal wave-form at TP 706.



Picture 21-4
Normal wave-form at base, Q 701.

oscillator output pin no. 14 to the base circuit of Q701. Otherwise, if the signal is present, trouble-shoot the 3.58 MHz amplifier stage. If you find no defective component in the surrounding circuits of IC701, the IC may be defective.

1 ***Trouble-shooting IC701 circuit***

Observe the output and input wave-forms of the IC. If an input wave-form is incorrect, check the components connected to the input pin. If an output wave-form is incorrect, the IC or the components connected to the output pin may be defective. Trouble-shoot the external circuit first before replacing the IC. Voltage and resistance measurements are very helpful in locating the defective component. In some cases, several pin voltages are far from normal. This usually confuses technicians. Study the circuit to find out what may be the trouble. Make resistance measurements to confirm if a suspected component is defective.

For example, when C1 in Fig. 21-6 is shorted, the colour is lost. In this case, the voltages at pins no. 2, 3, 4 and 11 become zero. A shorted C1, C2, C3, C4 or C5 will also cause the same symptom. It would be difficult to identify a shorted capacitor (C1 for instance) through voltage measurements alone. However, a continuity or resistance test will give away a shorted capacitor. Thus, in trouble-shooting, it is important to use a combination of voltage and resistance measurements to pinpoint the defective component.

The correct pin wave-forms, voltages and resistances for the IC in the circuit in Fig. 21-6 are given in Fig. 21-7.

2 ***Trouble-shooting the 3.58 MHz amplifier circuit***

The 3.58 MHz circuit in Fig. 21-6 is a simple amplifier circuit. The defective components can be easily located by measuring the voltages of the 3.58 MHz amplifier transistor (Q701).

Common troubles are defective 3.58 MHz amplifier transistor (Q701), open R1 in the collector circuit, shorted C6, open R2 or R3 in the emitter circuit, open R4 or R5 in the base circuit and shorted C7 or C8.

The voltages at several points in the circuit, as well as the common defective components, are indicated in the circuit diagram.

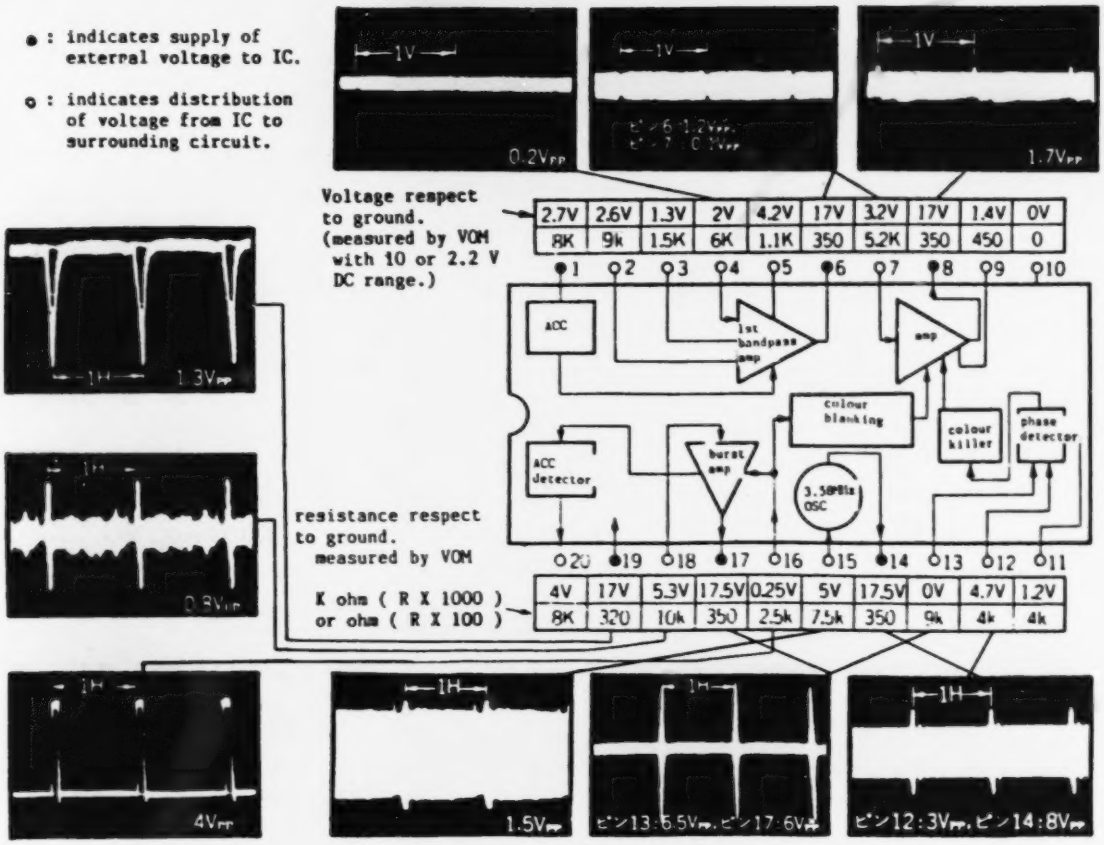

● : indicates supply of exterral voltage to IC.
o : indicates distribution of voltage from IC to surrounding circuit.
1V
0.2Vpp
1.7Vpp
Voltage respect to ground. (measured by VOM with 10 or 2.2 V DC range.)
2.7V 2.6V 1.3V 2V 4.2V 17V 3.2V 17V 1.4V 0V
8K 9k 1.5K 6K 1.1K 350 5.2K 350 450 0
1 2 3 4 5 6 7 8 9 10
ACC
1st bandpass amp
amp
colour blanking
colour killer
phase detector
ACC detector
burst amp
3.58MHz OSC
1H
1.3Vpp
0.8Vpp
resistance respect to ground. measured by VOM
K ohm (R X 1000) or ohm (R X 100)
20 19 18 17 16 15 14 13 12 11
4V 17V 5.3V 17.5V 0.25V 5V 17.5V 0V 4.7V 1.2V
8K 320 10k 350 2.5k 7.5k 350 9k 4k 4k
4Vpp
1.5Vpp
ピン13:6.5Vpp, ピン17:6Vpp
ピン12:3Vpp, ピン14:8Vpp

Fig. 21-7
Normal voltage, resistance and wave-forms at IC 701

22 No colour synchronisation

This symptom is characterised by an image with blurred or running colours. The colours either roll vertically or slide horizontally. The moving colours appear as colour bars or stripes. If the colour stripes are fine, the image seems to have no colour.

Cause: For an AFC colour synchronisation circuits similar to Fig. 22-1, the symptom may be caused by a trouble in the burst gate, phase amplifier, phase detector, DC amplifier or in the 3.58 MHz oscillator circuit.

For ringing colour synchronisation circuits, the symptom is caused by a defective crystal.

In vacuum-tube colour receivers, a trouble in the 3.58 MHz oscillator, phase shift, phase detector or burst amplifier circuit may cause the symptom.

TROUBLE-SHOOTING PROCEDURE

a **Solid-state circuits**

AFC colour synchronisation circuits. Fig. 22-3 shows a trouble-shooting flow chart for this circuit. Disable the colour killer (colour killer set at minimum)

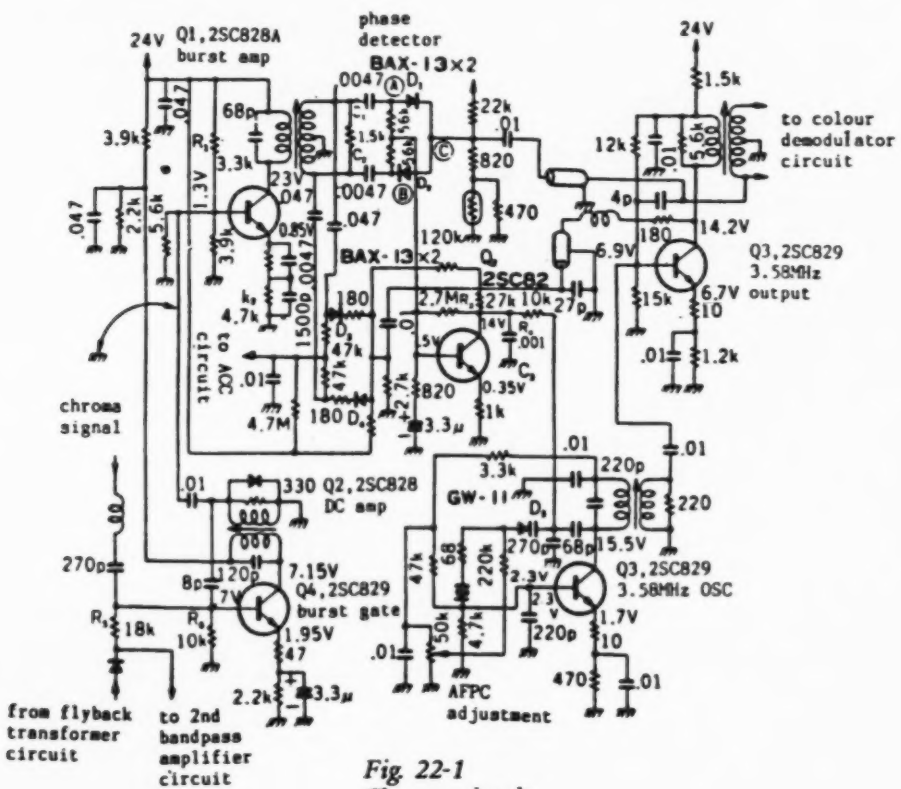


Fig. 22-1
Chroma circuit

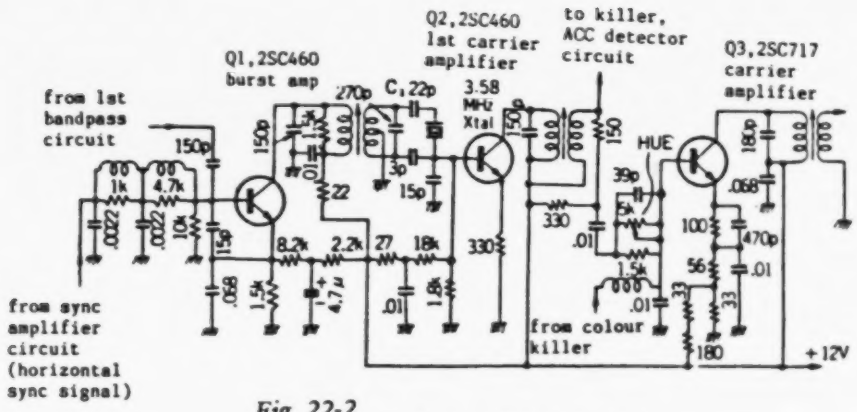


Fig. 22-2
Burst and carrier amplifier circuit

circuit and then ground the base of the burst amplifier transistor (Q1), as shown in Fig. 22-1. Adjust the AFPC control and while doing so, check whether the colour stripes move slowly sideways.

If the colour stripes do not move sideways, the trouble is either in the phase detector, DC amplifier or in the 3.58 MHz oscillator circuit.

If the colour stripes move slowly sideways, disconnect the short across the base of Q1 and ground. Check whether colour synchronisation can be obtained by adjusting the AFPC control. If colour synchronisation cannot be obtained, use an oscilloscope to check for the presence of the colour burst and the 3.58 MHz oscillator output signals in the phase-detector circuit.

Ringing colour synchronisation circuit. Since the defective components that may cause the symptom are constrained within the crystal circuit, check the crystal and the capacitor (C1) connected in series to it. It is hard to determine the condition of these components with a VOM, so replace any of them if they are suspected.

Generally speaking, colour sync loss seldom occurs in receivers using a ringing colour sync type circuit.

1 ***Trouble-shooting the burst gate and the burst amplifier circuit***

If the burst signal [refer to Pictures 22-1(a) and (b)] is not supplied to the phase-detector circuit, observe the wave-forms at the base and collector of the burst gate transistor (Q4) and the burst amplifier transistor (Q1). Normal wave-forms are shown in Picture 22-2. If any of the wave-forms observed are incorrect, use a VOM to locate the defective component in the circuit.

Common troubles are defective transistors or open R5 and R6 in the burst gate circuit, and an open R1 and R2 in the burst amplifier circuit. Refer to Fig. 22-1.

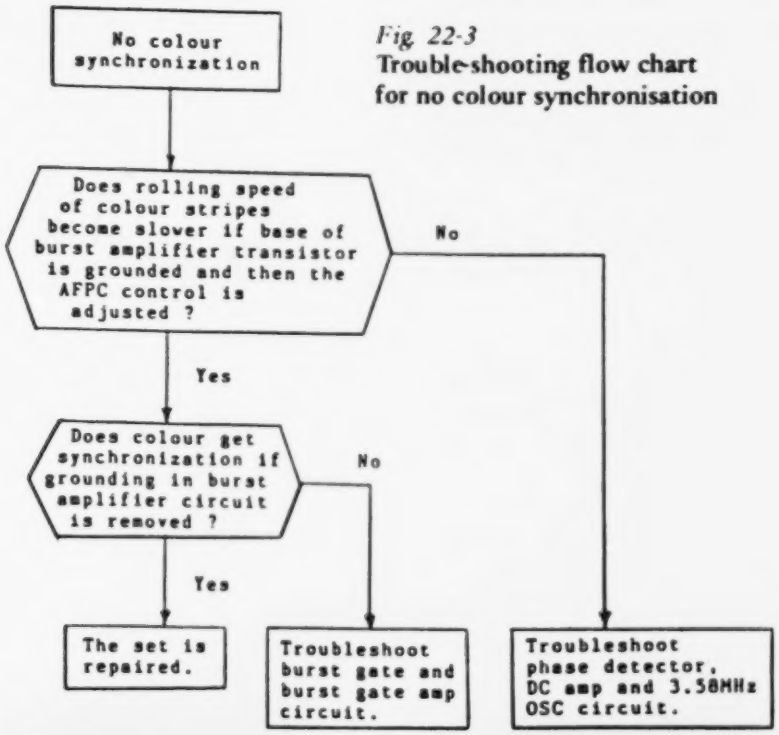
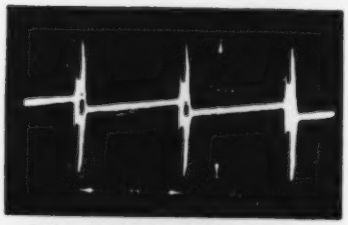
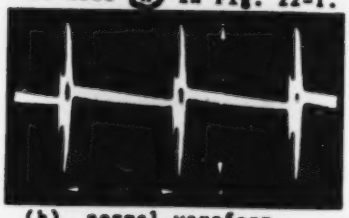

No colour synchronization
Does rolling speed of colour stripes become slower if base of burst amplifier transistor is grounded and then the AFPC control is adjusted ?
No
Yes
Does colour get synchronization if grounding in burst amplifier circuit is removed ?
No
Yes
The set is repaired.
Troubleshoot burst gate and burst gate amp circuit.
Troubleshoot phase detector, DC amp and 3.58MHz OSC circuit.

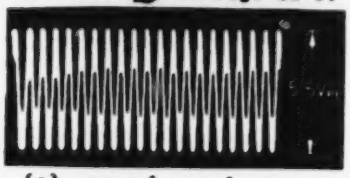
Fig. 22-3
Trouble-shooting flow chart for no colour synchronisation



(a), normal waveform at node (A) in Fig. 22-1.

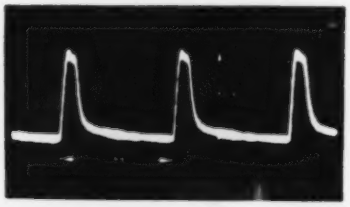


(b), normal waveform at node (b) in Fig. 22-1.

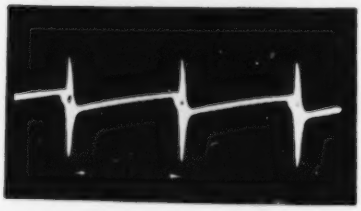


(c), normal waveform at node (c) in Fig. 22-1.

Picture 22-1



(a) normal waveform at base, burst gate.



(b) Normal waveform at collector, burst gate and amplifier.

Picture 22-2

2 ***Trouble-shooting the phase detector, DC amplifier and the 3.58 MHz oscillator circuits***

If trouble in any of these circuits is suspected, check the DC amplifier circuit first. An open R3 and R4 and a shorted C3 usually cause the symptoms. A defective D1, D2, C1 or C2 in the phase detector circuit will also cause the symptom. Refer to Fig. 22-1.

A breakdown in the 3.58 MHz oscillator circuit may shift the oscillation frequency and result in colour sync loss. But in most cases, the oscillator stops oscillating and results in colour loss instead of shifting from its oscillation frequency.

When the DC amplifier transistor Q2 becomes defective, the 3.58 MHz oscillator stops oscillating at a certain setting of the AFPC adjustment control. At this point, the colour is lost. This similar symptom can be observed when the phase-detector diode (D2) or C2 becomes shorted.

b **IC circuits**

The circuit diagram shown in Fig. 22-4 will be used for reference in this trouble-shooting procedure.

As shown in Figs. 21-7 and 22-4, an injection-lock-type circuit is used to inject the colour burst signal at the 3.58 MHz oscillator circuit. Thus, the symptom occurs when the frequency of the 3.58 MHz oscillator is shifted. In this case, adjust the core of transformer T705 and check whether you can get colour synchronisation. If you cannot get it, check for a change in the capacitance of C1, C2, C3 or C4. Refer to Fig. 22-4.

Technical memo

1 The change in the capacitance of a capacitor is hard to detect with a VOM. If a capacitor is suspected, always replace it with a new one.

2 If you get colour synchronisation after adjusting the core of T705, set the tint control at mid-position and readjust the core of T705 to get a normal skin colour.

Reference

If the circuit in Fig. 22-4 is used, colour loss results if the colour burst signals are not supplied to the 3.58 MHz oscillator circuit. If a similar circuit is used in the colour sync circuit, very seldom will colour sync loss occur.

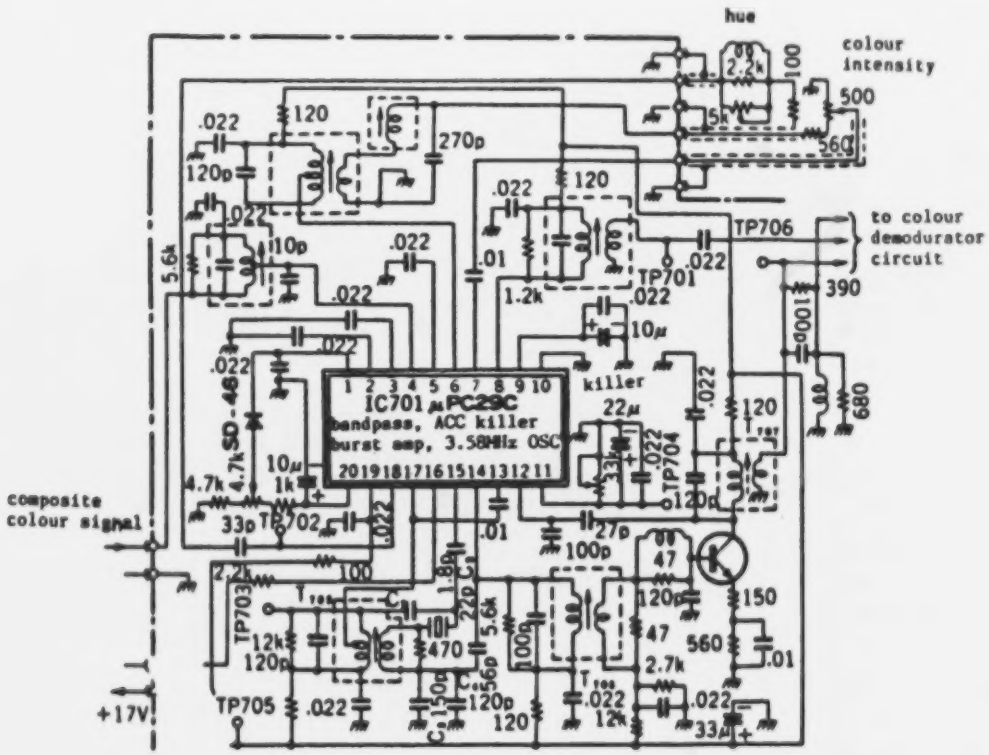


Fig. 22-4
IC bandpass and colour sync circuit

23 Improper colour

This symptom is characterised by the difficulty in getting the proper colour or hue of the picture through the adjustment of the hue control.

Cause: A trouble in the hue adjustment circuit or a detuning of the colour synchronisation circuit may cause the symptom. In rare cases, the trouble may be caused by the detuning of the phase-shift circuit.

TROUBLE-SHOOTING PROCEDURE

Adjust the colour hue control and check whether the hue of the picture changes. For receivers using the type of hue control circuit shown in Fig. 23-1 check the condition of the hue control (VR) and for an open R1. A defective hue control is indicated by a sudden change in the hue while adjusting or rotating the VR in one direction.

If these components are not defective, readjust the colour synchronisation circuit.

Technical memo

1 For receivers using a ringing colour sync circuit, a faulty burst amplifier circuit will cause the symptom.

2 In rare cases, the presence of excessive ghost signals and poor colour purity adjustment may cause the symptom.

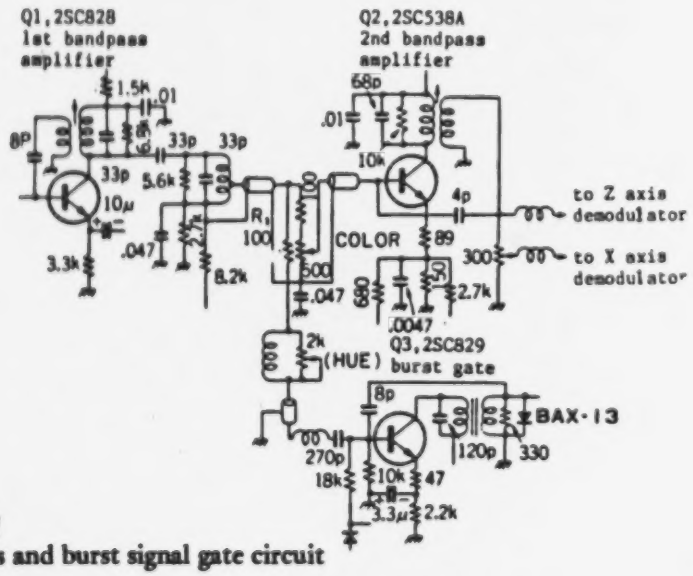


Fig. 23-1
Bandpass and burst signal gate circuit

Reference

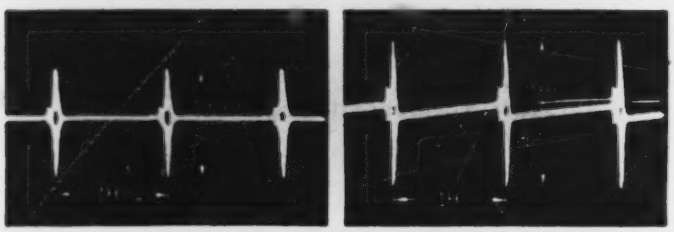
Adjustment of the chroma or colour sync circuit

1 Set the hue control in mid-position and tune the receiver to a colour broadcast signal or transmit a colour signal to the TV, using a colour bar generator. As illustrated in Fig. 23-2, adjust the core of the burst gate transformer (T1) while observing with an oscilloscope the wave-form (burst signal) across the base of the burst amplifier transistor and ground. Set the core of T1 to a setting where the burst signal has a maximum amplitude, as shown in Picture 23-1(a).

2 Observe the colour burst signal at the collector of the burst amplifier (Q1) or at the phase detector (node A in Fig. 23-2) relative to ground. Adjust the burst amplifier transformer for maximum amplification of the burst signal. See Picture 23-1(b).

3 Ground the base of the burst amplifier transistor (Q1) with a jumper wire. Adjust the AFPC control VR until the colour stripes on the image move slowly horizontally. After doing so, disconnect the short across base of Q1 and ground.

4 After the above adjustments, you should get the proper colour. If you cannot get the proper hue with the hue control in mid-position, set the hue control in mid-position and adjust the burst amplifier transformer (T2) slightly until you get the proper hue.



(a) base, burst amplifier transistor

(b) waveform at node (A) in Fig.23-2

Picture 23-1

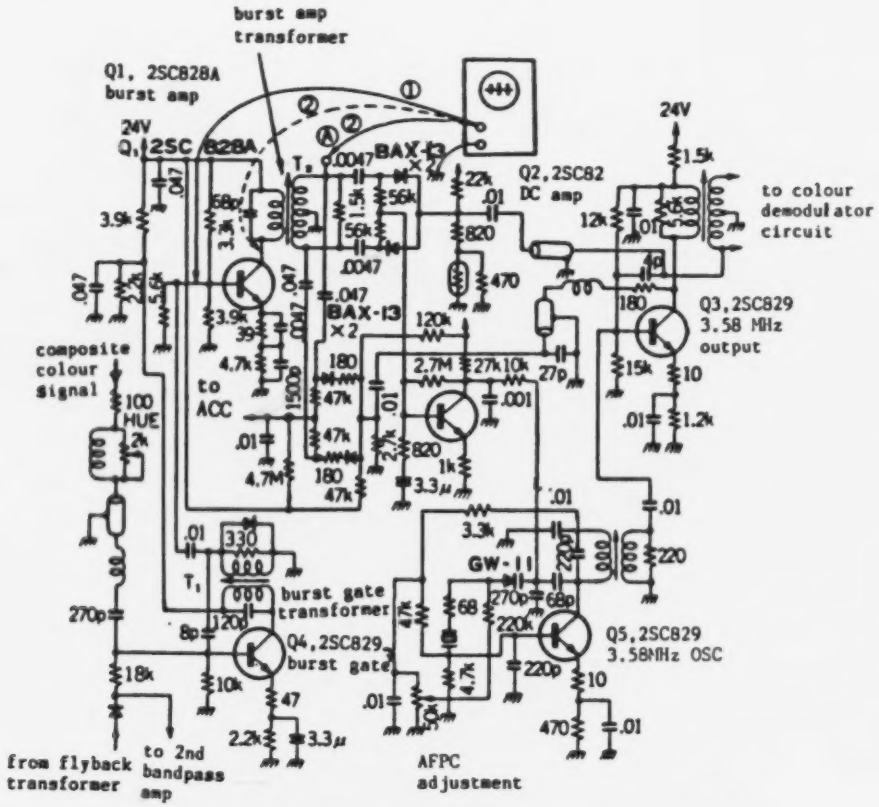


Fig. 23-2
Colour synchronisation circuit

24 Loss of one or two primary colours

This symptom is characterised by the loss of one or two primary colours. This symptom can be classified into three cases: 1) loss of red colour, 2) loss of blue colour and 3) loss of green colour.

Cause: This symptom may be caused by a trouble in the colour demodulator, in the colour amplifier or in the colour subtraction amplifier circuit.

TROUBLE-SHOOTING PROCEDURE

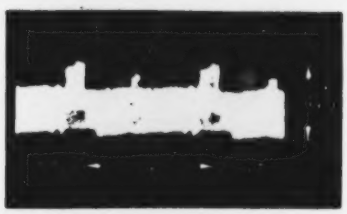
a **Solid-state circuits**

1 ***Loss in red colour***

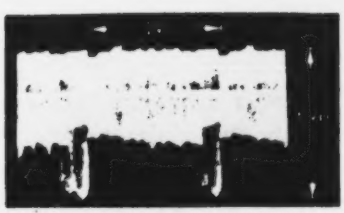
Tune the receiver to a colour broadcast station (a colour bar generator can be used to transmit a colour signal to the set). Check the X-axis demodulator, X-axis amplifier circuit or the R-Y output circuit for the chroma signal. If the colour signal is not present, use a VOM to locate the defective component in any of the above circuits. A breakdown in the X-axis amplifier or in the R-Y output transistor and an open collector resistor (R5 and R7 in Fig. 24-1) may cause the symptom. The normal wave-forms are shown in Picture 24-1.

2 ***Loss in blue colour***

Check the Z-axis demodulator, Z-axis amplifier and the B-Y output circuit. The trouble-shooting procedure is similar to the procedure discussed above. Observe the signal process with an oscilloscope. Check the transistors and the resistors in the collector circuit.



(a), base,
X-axis amplifier.



(b), collector,
X-axis amplifier.

(c), collector,
R-Y output.

Picture 24-1

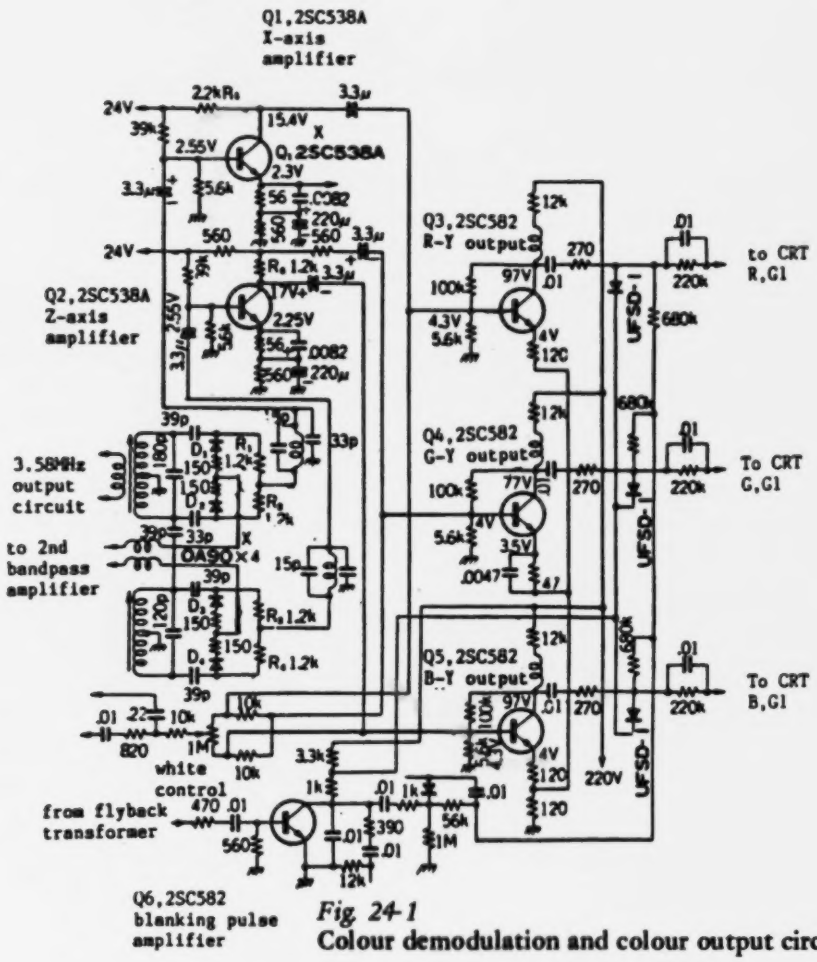


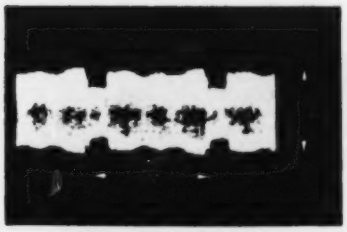
Fig. 24-1
Colour demodulation and colour output circuit

3 ***Loss in green colour***

In this case, check the transistor of the G-Y output circuit. This symptom is usually caused by a defective G-Y output transistor. An open collector resistor may also cause the symptom. In any case, the use of a VOM will be very helpful.

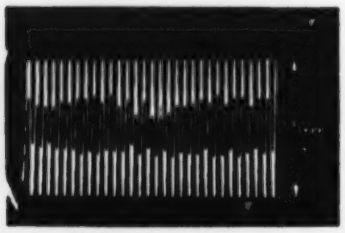
Technical memo

1 Before trouble-shooting, check the condition of the circuits succeeding the colour demodulator circuits. To check this out use a signal injector to apply a signal at the base circuit of the stage succeeding the demodulator circuits. If the X-axis amplifier circuit and the stages succeeding it are operative, red and cyan stripes will appear on the screen when a signal is fed to the base of the X-axis amplifier transistor. Similarly, blue and yellow stripes will appear on the screen when a signal is injected at the base of the Z-axis amplifier if this circuit and the other circuits succeeding it are operative.



Normal waveform at the anode of D1 in Fig. 24-1.

Picture 24-2



Normal waveform at cathode of D1 in Fig. 24-1.

Picture 24-3

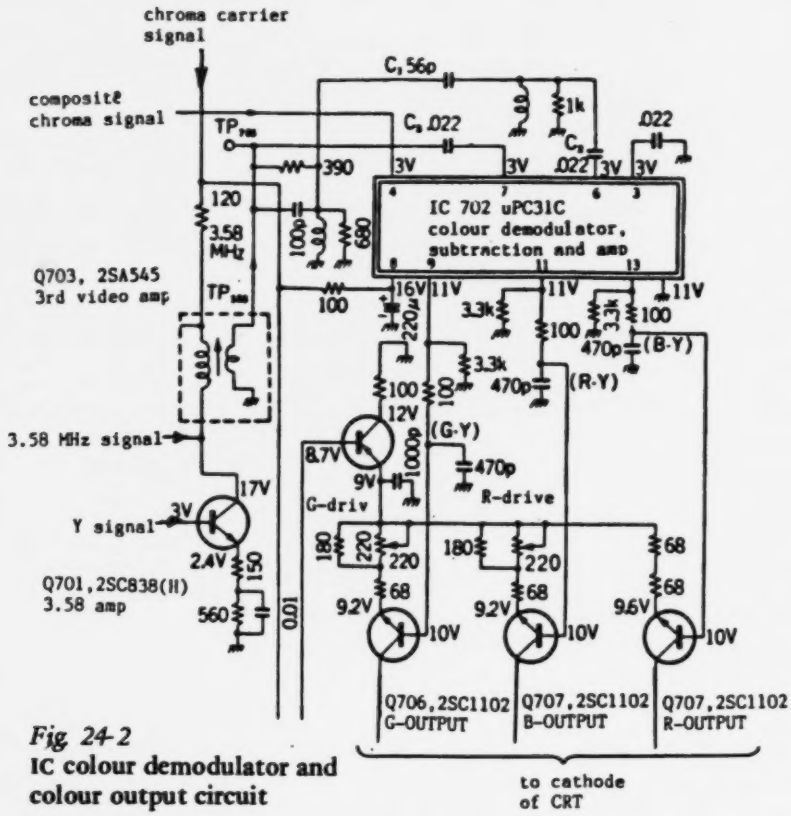


Fig. 24-2
IC colour demodulator and colour output circuit

2 Possible troubles in the X- and Z-axis demodulators are open resistor/s (R1, R2, R3 or R4) and open diode/s (D1, D2, D3 or D4) in Fig. 24-1. Check out the condition of these components by observing the wave-forms at both sides of the diodes. Check for the presence of the colour subcarrier signal at one end and the 3.58 MHz oscillator signal at the other end. These signals are shown in Pictures 24-2 and 24-3, respectively. If both signals are present, the X- or Z-axis demodulators may have an open diode and/or resistor.

b IC circuits

In this section the circuit in Fig. 24-2 will be used for reference.

1 *Loss in red colour*

In the circuit in Fig. 24-2 the IC functions as a colour demodulator and a colour subtraction signal amplifier. The functional block diagram of this IC is shown in Fig. 24-3. It consists of two colour demodulators, a matrix circuit and three colour subtraction signal amplifier circuits. The colour signal fed to pin no. 4 is supplied to the R-Y and to the B-Y colour demodulators simultaneously, while the 3.58 MHz signal is supplied to the R-Y colour demodulator through pin no. 6. A trouble in the R-Y demodulator circuit or a defective component between TP706 and pin no. 6 of IC702 may cause a loss in the red colour. Examples are open C1 or C2, or a shorted C2 in Fig. 24-2. To isolate the troubles in the circuit, measure the voltage and the resistance of pin no. 6 relative to ground. However, note that the handling voltage of the circuit is low, thus the chances of a breakdown in the components are expectedly less.

2 *Loss in blue colour*

As shown in Fig. 24-3, the colour subcarrier signal fed to pin no. 4 is supplied to the R-Y and the B-Y demodulators. The 3.58 MHz signal is supplied to the B-Y demodulator circuit through pin no. 7. Thus, a breakdown in the B-Y modulator circuit in the IC or a defective component (C3) between TP706 and pin no. 7 will cause the symptom. To identify the defective block, observe the wave-form at pin no. 7 and measure its voltage and resistance with respect to ground. The defective components that have to do with the symptom are IC702 and C3 in Fig. 24-2.

Technical memo

1 It is not proper to assume that the circuit between TP706 and pin no. 6 of IC702 is normal after observing a proper wave-form at pin no. 6. Refer to Picture 24.3. For example, a shorted C2 will not affect the wave-form at pin no. 6 but will surely cause the symptom.

When C2 is shorted, the voltage and resistance of pin no. 6 relative to ground becomes zero (normally 3 V and 5 kilo ohm, respectively). Observing the wave-form with an oscilloscope is very effective in locating the defective stage but is not sufficient in identifying the defective components. The use of an oscilloscope and a VOM will give the most effective result.

2 A shorted or an open C3 will also cause the symptom (loss in blue colour). Observe the wave-form at pin no. 7 of IC702 and at TP706. If the 3.58 MHz signal (refer to Picture 24-3) is observed at TP706 and not at pin no. 7, an open C3 is confirmed. A shorted C3 can be easily detected by measuring the voltage and resistance of pin no. 7. In Fig. 24-2 the most likely defective components and the normal voltages are included.

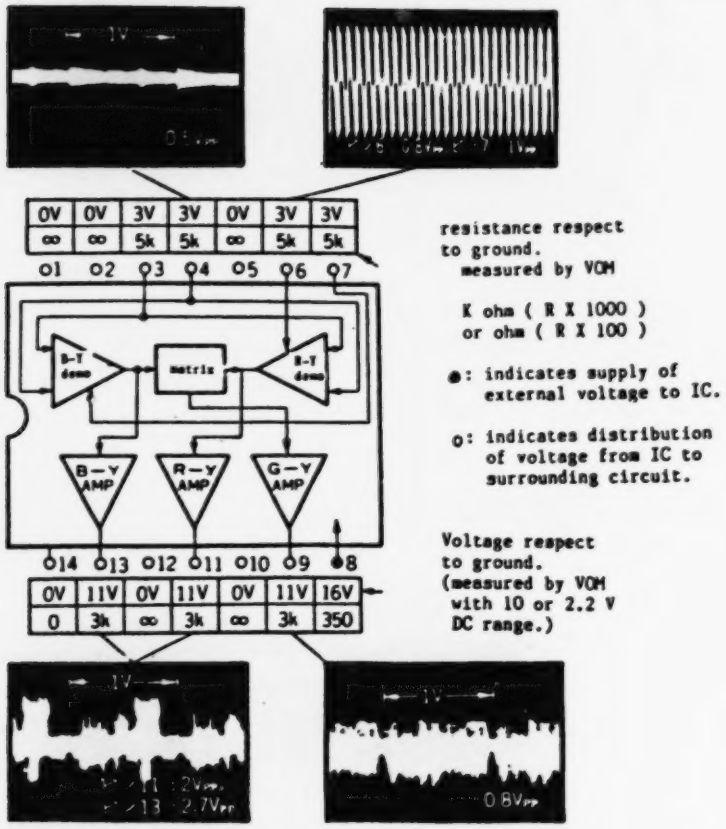

1V
0.8Vpp
0V 0V 3V 3V 0V 3V 3V
∞ ∞ 5k 5k ∞ 5k 5k
O1 O2 O3 O4 O5 O6 O7
B-Y demo
matrix
R-Y demo
B-Y AMP
R-Y AMP
G-Y AMP
O14 O13 O12 O11 O10 O9 ●8
0V 11V 0V 11V 0V 11V 16V
0 3k ∞ 3k ∞ 3k 350
1V
2Vpp
2.7Vpp
1V
0.8Vpp
resistance respect to ground. measured by VOM
K ohm (R X 1000) or ohm (R X 100)
●: indicates supply of external voltage to IC.
o: indicates distribution of voltage from IC to surrounding circuit.
Voltage respect to ground. (measured by VOM with 10 or 2.2 V DC range.)

Fig. 24-3
Normal voltage, resistance and wave-forms in IC 702

25 Weak colour

This symptom is also usually referred to as *faded or insufficient colour.* It is characterised by a weak maximum colour reproduction. This symptom can be divided into two cases: 1) weak colour in all channels and 2) weak colour in some stations.

Cause: Weak colour in all channels is caused by a breakdown in the ACC circuit or by a bandpass amplifier with a decreased gain. Weak colour in some stations is caused by a poorly tuned fine-tunning circuit, a mismatch between the antenna and the feeder cable, a defective antenna, a defective feeder cable or an ageing tuner.

TROUBLE-SHOOTING PROCEDURE

Set the colour control at maximum and then adjust the fine-tuning circuit with the fine-tuning knob to get maximum colour for every station. If only some stations have weak colour, check the condition and the matching of the antenna and the feeder cable. A mismatch between the antenna and the feeder cable affects the receiver's reception and good colour reproduction cannot be expected. Otherwise, if all channels have weak colour and the colour strength is not uniform, trouble-shoot the ACC and the bandpass amplifier.

A simple method of detecting a mismatch is to wrap the antenna cable just before the antenna terminals of the receiver with an aluminium foil about 10 cm long. Move the foil slowly away from the antenna terminals and observe its effect on the colour on the screen. If the colour intensity changes as the foil is moved, then a mismatch between the cable and the antenna is confirmed. This mismatch causes weak colour reproduction.

Trouble-shooting the ACC and the bandpass amplifier circuit

For chroma circuits similar to Fig. 25-1, a breakdown in the ACC (Automatic Colour Control) circuit will reduce the gain of the first bandpass amplifier circuit. This will result in a decrease in the overall gain of the bandpass amplifier block. Open resistors (R1, R2 or R3) and shorted base-emitter or emitter-collector junctions of Q1 are likely troubles. Refer to symptom [21] (No colour) for a more extensive procedure in trouble-shooting the bandpass amplifier circuit.

Reference

The ACC circuit keeps the strength of the chroma signals of different stations at a constant level for the colour circuits of the receiver. The ACC circuit in Fig. 25-1 consists of two transistor (Q2 and Q4) stages. The colour killer detector output signal is amplified by the ACC amplifier transistor (Q4) and then coupled to the base of the ACC amplifier transistor (Q2).

The internal resistance of Q2 is controlled by the output signal of Q4, and

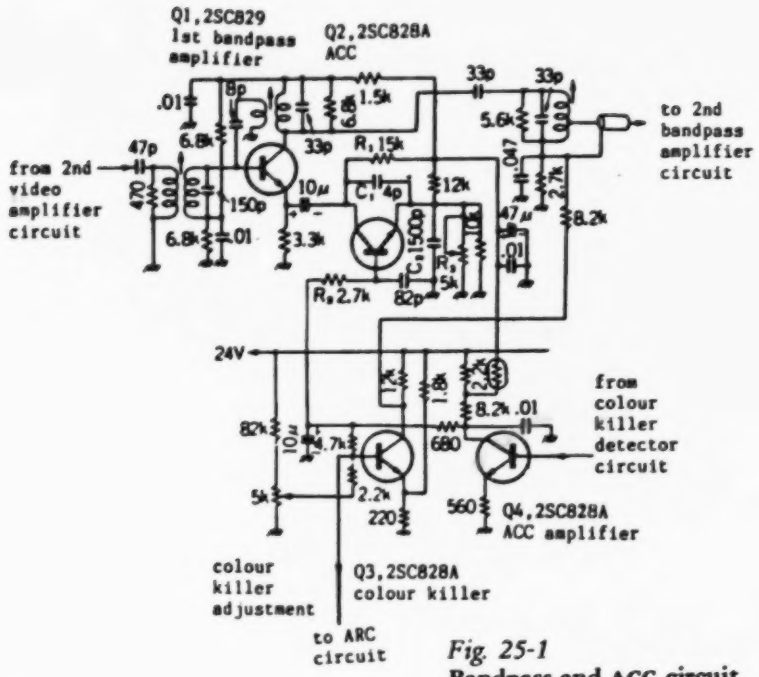


Fig. 25-1
Bandpass and ACC circuit

the emitter feedback of the first bandpass amplifier transistor (Q1) depends on the internal resistance of Q2. By varying the internal resistance of Q2, the feedback current and the gain of Q1 can be controlled. Since the output of Q4 (or the colour killer detector output) is proportional to the strength of the colour burst signal, the gain of the bandpass amplifier is either increased or decreased, depending on the strength of the burst signal. The ACC circuit maintains a constant level for the bandpass amplifier output despite variations in the strength of the chroma signal of different stations.

However, when the ACC circuit becomes defective, the internal of the ACC transistor (Q2) increases. This defect increases the negative feedback of the bandpass amplifier (Q1), resulting in a decrease in the gain of the entire bandpass amplifier circuits. This decrease accounts for weak colour reproduction in all channels.

26 Non-uniform colour strength

This symptom is characterised by a loss of colour in a particular or in some stations or by differences in the colour intensity of different stations.

Cause

1 ***Colour loss in a particular or in some stations.*** A drift in the local oscillator frequency towards a lower value or a faulty contact in the tuner usually causes the symptom. Improper adjustment of the colour killer control or a breakdown in the antenna system is also a possible cause.

2 ***Differences in colour intensity of different stations.*** A mismatch between the antenna and the feeder cable, an ageing RF tuning circuit or a breakdown in the ACC circuit are possible causes.

TROUBLE-SHOOTING PROCEDURE

1 ***Colour loss in a particular or in some stations***

First, adjust the fine-tuning control and see if you can get the colour. Misadjustment of the local oscillator not only causes the symptom but also produces the sound distortion (difference between the SIF sound intermediate frequency signal and the colour subcarrier frequency), which creates a wavy and distorted picture.

If you cannot get the colour by adjusting the fine-tuning control, check the tuner for a faulty contact and the setting of the colour killer control adjustment.

2 ***Differences in colour intensity of different stations***

Check the condition of the antenna system. Refer to symptom [25] on how to detect a mismatch between the antenna and the feeder cable. If there is no mismatch, observe the tuner response with a sweep-marker generator and an oscilloscope. Semiconductor components in solid-state tuners do not age. Thus, if an ageing of a solid-state tuner is suspected, replace it with a new one.

Technical memo

1 For ACC circuits similar to Fig. 26-1, a shorted emitter-collector junction or a shorted capacitor may be the trouble. A shorted C2 may also cause the symptom.

Shorted capacitors can be easily detected by measuring the pin voltages of Q2. If the collector voltage and the emitter voltage of Q2 are equal, the emitter-collector junction of Q2 or C1 is shorted. If the emitter voltage is zero relative to ground or is constant despite adjustments in the 5 kilo ohm variable resistor in the emitter circuit, then C2 is shorted.

2 An overloading in the antenna or an excessive VSWR value may also cause the symptom. In this case, use the attenuator shown in Fig. 26-2.

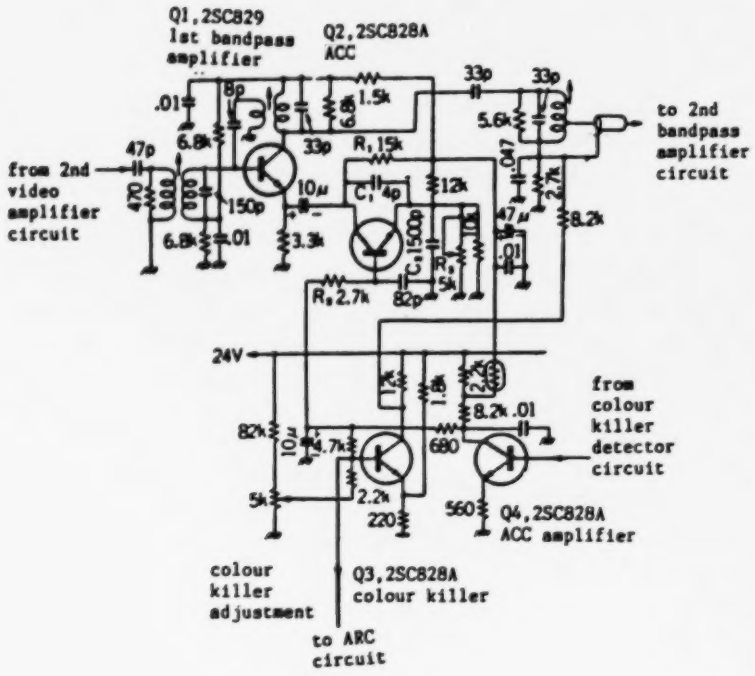


Fig. 26-1
ACC circuit

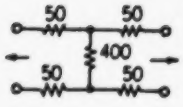


Fig. 26-2
Attenuator

27 Poor colour purity

This symptom is characterised by colour impurities on the corners of the screen or all over the screen. Colour impurities are easily detected during monochrome reception. Colour on the screen during black-and-white reception indicates poor colour purity.

Cause: This symptom is caused by the magnetised shadow mask or the metal support of the CRT, or by a poor colour purity adjustment.

Remedy: Demagnetise the shadow mask and the metal support with a demagnetiser or a degaussing coil. Readjust the colour purity rings, as shown in Picture 27-1, if necessary.

Technical memo

1 Almost all colour receivers have an ADC (Automatic Degaussing Circuit) to demagnetise the shadow mask and the metal support of the CRT every time the receiver is switched on. Check the ADC. If it is operating properly, there is no need for external degaussing.

2 After adjusting the colour purity, the convergence of the colour CRT may change slightly owing to a change in the position of the yoke coil. If the convergence is affected by the colour purity adjustment, readjust the convergence.

Picture 27-1

28 Poor convergence all over the screen

This symptom is characterised by colour fringes all over the screen. There are different types of colour fringes: 1) red and cyan fringes, 2) green and magenta fringes and 3) blue and yellow fringes.

Cause: Fringing of red and cyan colours is caused by a misadjustment of the red static convergence magnet, green and magenta fringing by a misadjustment of the green static convergence magnet, and blue and yellow fringing by a misadjustment of the blue static convergence magnet.

Remedy: Get a pattern generator and produce a dot pattern on the screen. Observe carefully the dots on the centre of the screen while adjusting the static convergence magnets to converge the three electron beams into a small dot on the screen. For blue or yellow fringing, adjust the static convergence magnet if the fringing is observed to be vertical, and adjust the blue lateral convergence adjustment magnet if the fringing is observed to be horizontal.

29 Poor convergence on the sides of the screen

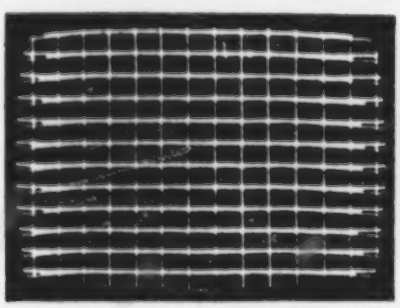
This symptom is characterised by colour fringes on both sides or on the upper and lower sides of the screen. This trouble is generally due to a poor dynamic convergence.

Cause

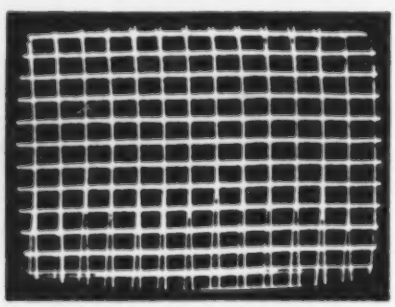
a **For delta gun CRT**

1 ***Colour fringes on both sides of the screen.*** This symptom may be caused by a misadjustment in the horizontal convergence circuit, an open circuit in the horizontal convergence coil, a breakdown in the horizontal convergence circuit or an open circuit in the flyback coil which supplies the flyback pulses to the convergence coil. Refer to Picture 29-1 for an example of poor convergence on both sides of the screen.

2 Colour fringes on the upper and lower sides of the screen. This symptom may be caused by a misadjustment in the vertical convergence, an open circuit in the vertical convergence coil or an open circuit in the convergence winding within the vertical output transformer. Refer to Picture 29-2 for an example of poor convergence on the upper and lower sides of the screen.



Picture 29-1



Picture 29-2

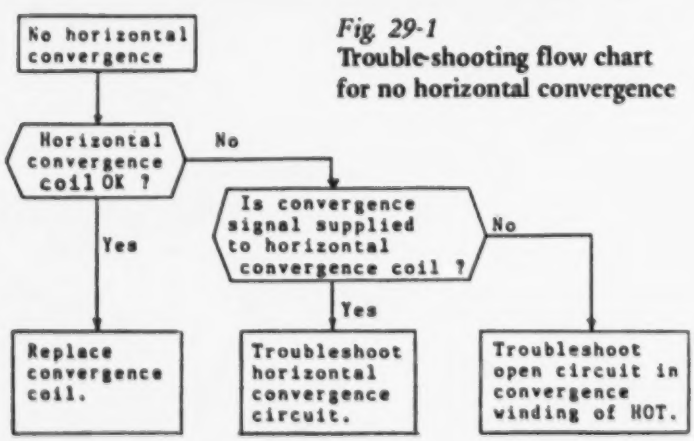


Fig. 29-1
Trouble-shooting flow chart for no horizontal convergence

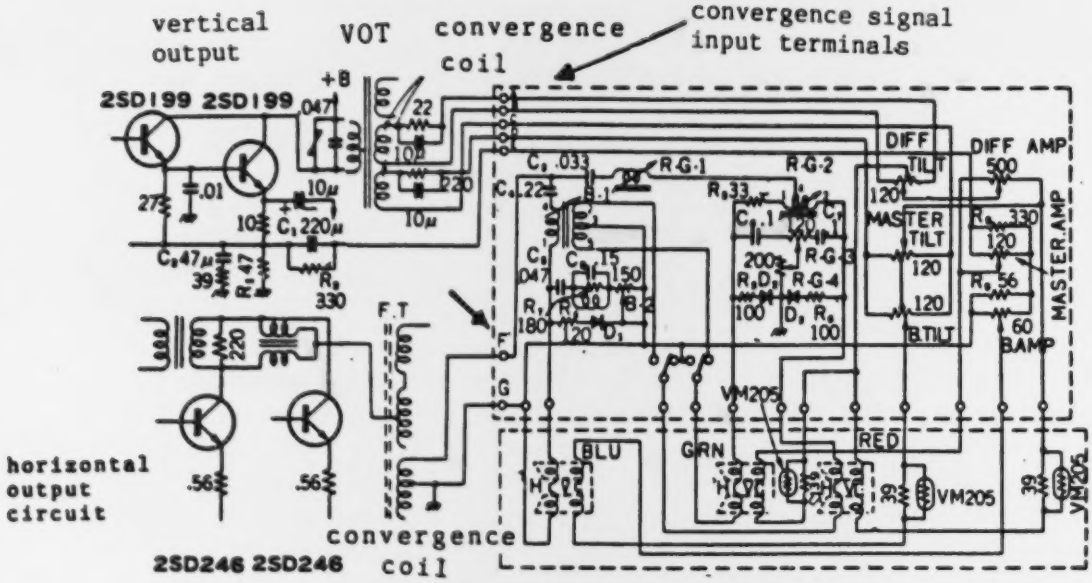


Fig. 29-2
Convergence circuit

TROUBLE-SHOOTING PROCEDURE

a ***Colour fringes on both sides of the screen***

Use a pattern generator to produce a cross-hatch pattern on the screen, then re-adjust the horizontal convergence controls to converge the beams at the sides of the screen. If the beams cannot be converged by adjusting the horizontal convergence controls, use the flow chart in Fig. 29-1 to isolate the defective circuit. Check for an open circuit in the horizontal convergence coil. If there is no open circuit, observe the wave-form at terminal F in the horizontal convergence circuit in Fig. 29-2. Generally, the pulse voltage signal shown in Picture 29-3 can be observed.

If the pulse voltage signal is not present at terminal F, check for an open circuit in the convergence winding of the flyback transformer. If the pulse voltage is present, trouble-shoot the horizontal convergence circuit (convergence board).

If a trouble in the convergence board is suspected, produce a cross-hatch pattern on the screen and adjust the controls on the convergence board. While doing so observe carefully the movement of the cross-hatch lines to identify the defective part.

Technical memo

1 The DC (static) resistance of the horizontal convergence coil is around 7 to 9 ohms. Since its resistance is very low, it is "not necessary" to disconnect it from the convergence board when measuring its resistance. If the resistance measured is around 20 to 50 ohms or above, the horizontal convergence coil has an open circuit.

2 A VOM (250 V/AC range) can be used to detect the presence of the pulse voltage supplied to the horizontal convergence circuit from the convergence winding of the flyback transformer. A reading of around 60 V indicates the presence of the pulse voltage.

3 In most cases, the trouble in the convergence circuit is a mechanical breakdown. Give emphasis to mechanical components such as potentiometers and the cores of the coils. Use the proper tools when trouble-shooting to avoid additional physical damage.

b Colour fringes on the upper and lower sides of the screen

Adjust the vertical convergence controls and check if the colour fringes can be eliminated. If the colour fringes cannot be eliminated, isolate the defective component with the aid of the set's service manual. Check the convergence coil for an open circuit. If the convergence coil is not defective, check the pulse voltage signal supplied by the vertical output circuit to the vertical convergence circuit.

If the pulse voltage is supplied to the convergence board, trouble-shoot the vertical convergence circuit. If the pulse voltage is absent, check the convergence winding of the vertical output transformer for an open circuit.

If the vertical convergence board is suspected to be defective, produce a cross-hatch pattern on the screen. Readjust the controls of the vertical convergence adjustment and observe carefully the movement of the beams on the screen to identify the faulty control circuit. Since the movement of the beams with respect to the convergence control adjustments varies in different manufacturers, the possible troubles are usually shown in the manual.

Technical memo

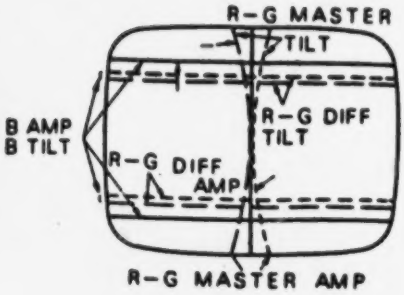
1 The DC resistance of the vertical convergence coil is around 110 to 150 ohms. This value is close to the value of the vertical convergence potentiometer. Thus it is necessary to disconnect the vertical convergence coil in checking its resistance or continuity.

2 The presence of the pulse voltages from the vertical output transformer is easily determined with an oscilloscope. Refer to Picture 29-4 for the proper wave-forms.

3 As shown in Fig. 29-2, low-valued resistors are used in the vertical convergence circuit. This makes it difficult to identify open resistors. For resistance and continuity tests, disconnect one end of the component from the circuit.

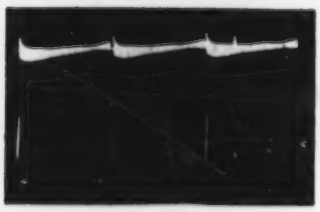
4 Besides the defective components in the convergence circuit, a shorted or open C1 or open R2 in the vertical output circuit in Fig. 29-2 will also cause the symptom.

Picture 29-3
Normal wave-form at node F in Fig. 29-2



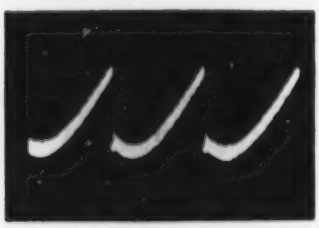
(a) node A

(b) note B



(c) node C

(d) node D



(e) node E

Picture 29-4
Normal wave-forms at the input of convergence board shown in Fig. 29-2

30 Coloured raster

This symptom is characterised by the presence of red, cyan, green, magenta, blue or yellow colour in a supposedly plain white raster. Proper colour reproduction cannot be expected if the raster is coloured.

Cause: This symptom is caused by a poor white balance adjustment or by a trouble in the CRT, colour amplifier, colour demodulation or colour output circuits.

TROUBLE-SHOOTING PROCEDURE

For circuits similar to Fig. 30-2, refer to the flow chart in Fig. 30-1(a) for trouble-shooting. If the raster has a tint of red or cyan, check the R-Y output circuit and the first grid, second grid and cathode circuits of the red electron gun. If the raster is tinted blue or yellow, check the B-Y and the first grid, second grid and cathode circuits of the blue electron gun. If the raster is tinted green or magenta, check the G-Y output and the first grid, second grid and cathode circuits of the green electron gun.

For circuits similar to Fig. 30-3, refer to the flow chart shown in Fig. 30-1(b). If the raster is tinted red or cyan, check the R-Y demodulator, R-Y amplifier, R colour output amplifier and the cathode and second grid circuit of the gun. Similarly, for the other tints of colour, check the associated demodulator or grid circuits.

If the raster is tinted with a primary colour, check the first grid, second grid and cathode voltages of the electron gun of that primary colour. The raster is tinted with a primary colour when the first or second grid voltage increases or when the cathode voltage decreases. On the other hand, if the first or second grid voltage has decreased, the cathode voltage has increased or an open circuit is developed in the cathode circuit, the raster becomes tinted with secondary colour.

1 ***Trouble-shooting the colour subtraction amplifier circuit***

Referring to Fig. 30-2, if the first grid voltage is higher than normal, check for a shorted C1, C2, C3, D1, D2 or D3. If the first grid voltage is very low, check for an open R4, R5 or R6. Note that the grids are not connected to each other. So, check only the components that are connected to the affected grid circuit.

2 ***Trouble-shooting the CRT circuit***

If the first grid voltage of a particular gun is zero, check for an open resistor in that grid circuit (R10, R11 or R12). If the second grid voltage of a particular gun is zero, check for an open resistor in the second grid circuit (R18, R19 or R20).

If the second grid voltage of a particular gun is extremely higher than normal, adjust the potentiometer which controls the second grid voltage of that

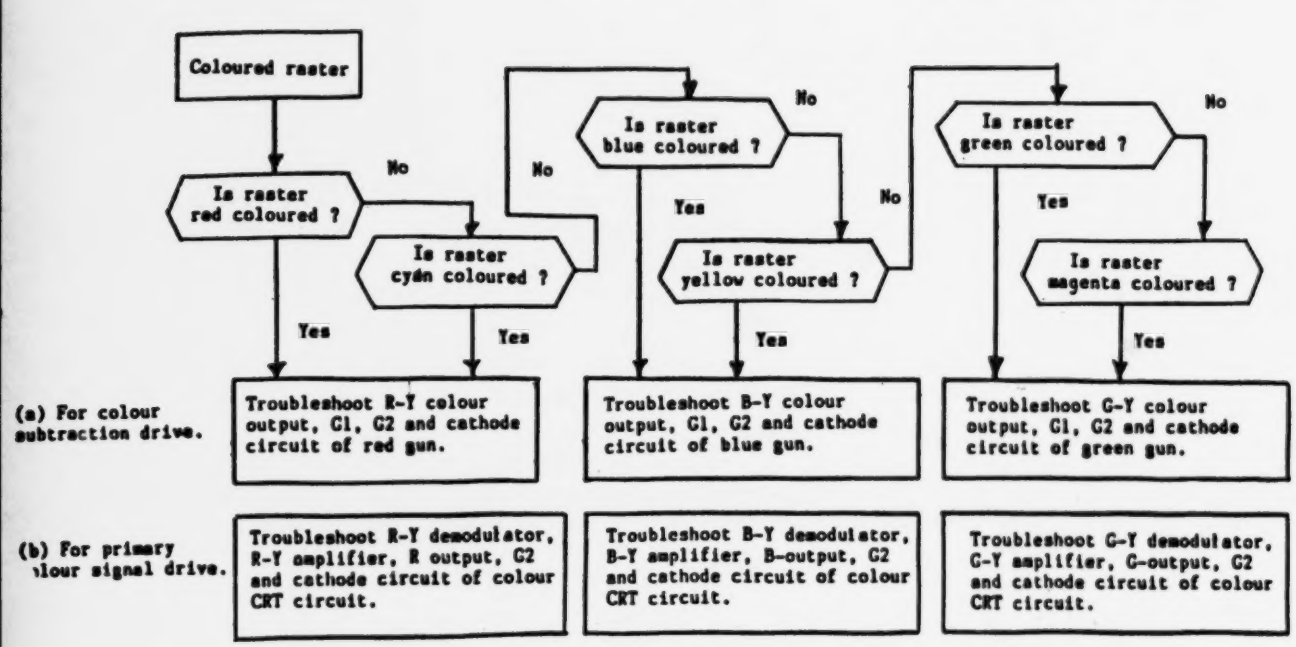

Coloured raster
Is raster red coloured ?
No
Yes
Is raster cyan coloured ?
No
Yes
Is raster blue coloured ?
No
Yes
Is raster yellow coloured ?
No
Yes
Is raster green coloured ?
No
Yes
Is raster magenta coloured ?
Yes
(a) For colour subtraction drive.
Troubleshoot R-Y colour output, C1, G2 and cathode circuit of red gun.
Troubleshoot B-Y colour output, C1, G2 and cathode circuit of blue gun.
Troubleshoot G-Y colour output, C1, G2 and cathode circuit of green gun.
(b) For primary colour signal drive.
Troubleshoot R-Y demodulator, R-Y amplifier, R output, G2 and cathode circuit of colour CRT circuit.
Troubleshoot B-Y demodulator, B-Y amplifier, B-output, G2 and cathode circuit of colour CRT circuit.
Troubleshoot G-Y demodulator, G-Y amplifier, G-output, G2 and cathode circuit of colour CRT circuit.

Figure 30-1
Trouble-shooting flow chart for coloured raster

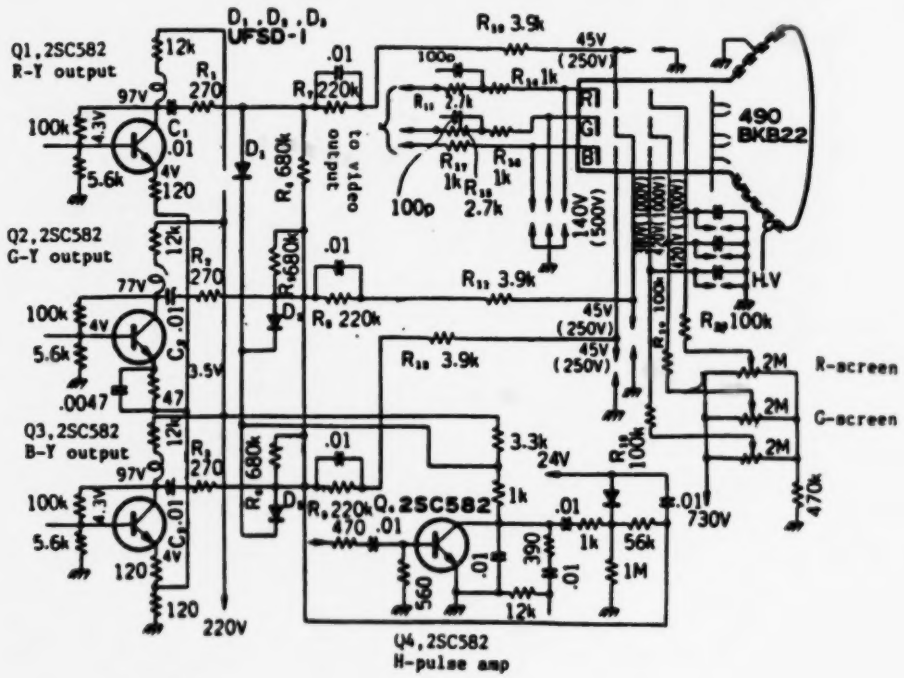


Fig. 30-2
Colour and amplifier circuit

particular gun. If the variation in the voltage is not linear, check the circuit between the centre tap of the potentiometer and ground. If there is no trouble detected in the first and second grid circuits of the CRT circuit, check for open R13, R14, R15, R16 or R17 in the cathode circuit.

3 ***Trouble-shooting the primary colour reproduction and drive circuits***

Referring to Fig. 30-3, if the cathode voltage of a particular gun is extremely higher than the others, the trouble is located anywhere from the colour demodulation circuit to the primary colour output circuit, since all the stages in between are DC coupled. A slight voltage change in a single stage causes a considerably large voltage change in the succeeding stages. The defective stage can be detected by measuring the voltages of the colour subtraction signal amplifier and the primary colour output transistors. Refer to the voltages indicated in the circuit diagram.

Technical memo

1 In some cases, for circuits similar to Fig. 30-2, the white-balance adjustment of the receiver is disrupted (raster becomes tinted) when the receiver is tuned to another channel or when the TV is switched on after switching off. This happens when the first grid voltage of a particular gun is zero. In this case, check for an open R7, R8 or R9 in the first grid circuit.

2 An open R13, R14, R15, R16 or R17 in the cathode circuit of the CRT is hard to detect using voltage measurements. Better perform continuity or resistance measurements to determine their conditions.

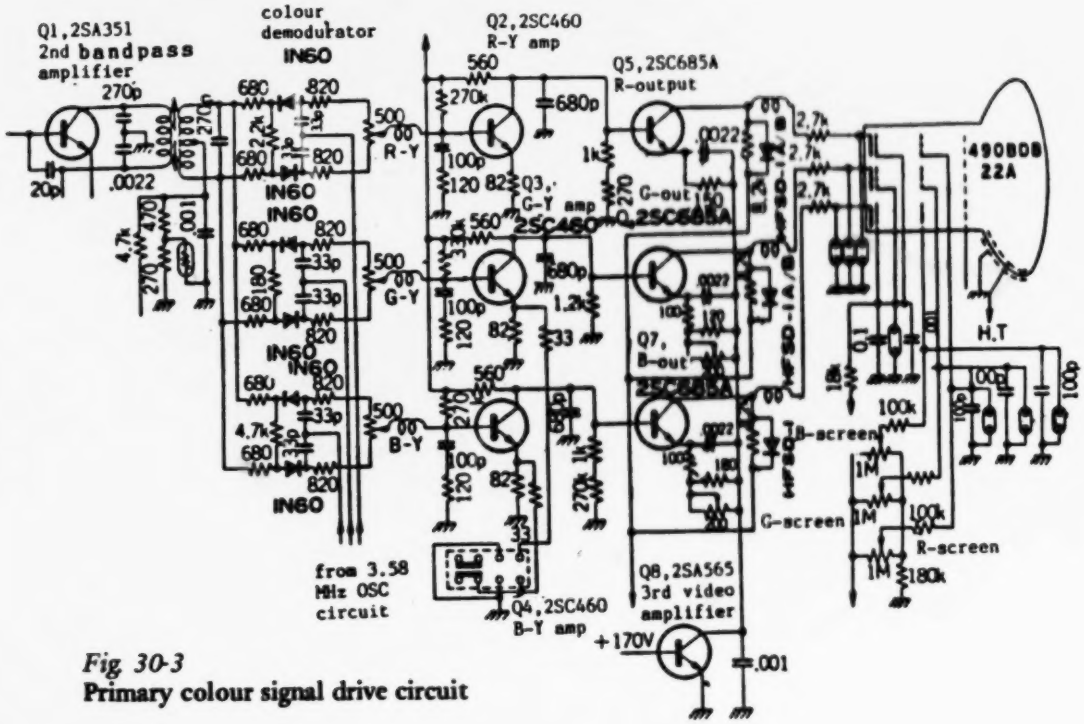


Fig. 30-3
Primary colour signal drive circuit

Trouble-shooting an IC circuit

The circuit shown in Fig. 30-4 will be used for reference in this section. The circuit is a primary colour drive circuit which uses an IC as a colour demodulator and a colour subtraction signal amplifier circuit.

TROUBLE-SHOOTING PROCEDURE

Refer to the flow chart in Fig. 30-1. Check the cathode voltages of the colour CRT first. If cathode voltages are approximately equal, check the voltages of the primary colour output transistors.

Technical memo

In measuring transistor voltages, it is important to compare the measured values with the values given in the diagram. If the trouble is in the base circuit, the difference between the correct and the measured voltage is very small. Thus it is possible to miss a breakdown in the base circuit.

For example, when R1 in Fig. 30-4 becomes open, the pin voltages of the blue output transistor (Q707) becomes as listed in Chart 30-1. When comparing these voltages to the normal voltages of the red and green output transistor (Q705, Q706), you will notice that the difference between the normal base and emitter voltages and the measured base and emitter voltages is only 1 V. This difference may sometimes be missed if the VOM is not very accurate. The difference between the collector voltage, however, is from 60 to 70 V.

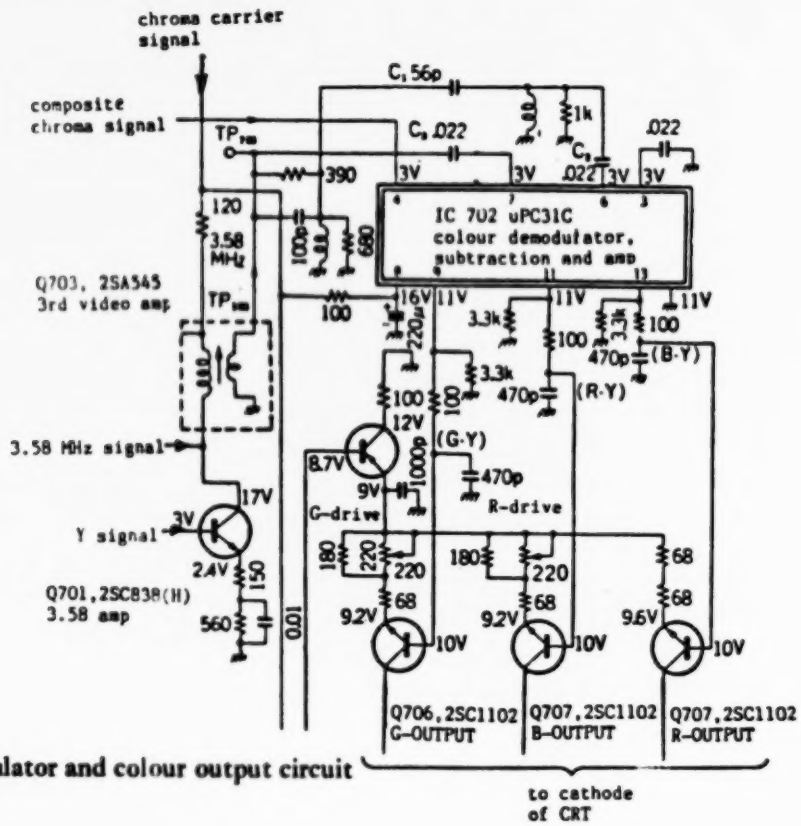


Fig. 30-4
IC colour demodulator and colour output circuit

31 Colour smear

This symptom is also called "colour blotting" and is characterised by images with smeared or blurred colours. There are two variations observed in this symptom. One is the smearing of a particular colour, the other of all colours.

Cause: Smearing a particular colour is caused by a trouble in the phase response of the colour subtraction amplifier circuit related to the smeared colour. Smearing of all colours is caused by a bandpass amplifier circuit with a decreased frequency response.

TROUBLE-SHOOTING PROCEDURE

The chances of this kind of symptom occurring in transistor receivers are lesser than in tube-type receivers.

Tune the receiver to other stations and check if the symptom occurs in all channels. If the symptom is present in all channels, observe whether the smear is only on a particular colour or on all colours.

If only a particular colour is smeared, check the colour subtraction amplifier circuit related to the smeared colour. For example, if the red colour is smeared, check the R-Y amplifier circuit. Most of the time, an open load resistor or an open coupling capacitor (C in Fig. 31-1) causes the symptom.

If all the colours are smeared, check the response of the bandpass amplifier circuit by using a sweep and marker generators and an oscilloscope.

Technical memo

1 In vacuum-tube colour TV sets, an open load resistor or open coupling capacitor in the colour subtraction amplifier sometimes does not cause the symptom described.

Instead, an open load resistor will disrupt the white-balance of the raster, and an open coupling capacitor will reduce the amount of colour reproduced.

2 A symptom similar to colour smear happens where the colours of the picture are shifted to the right by about a few millimetres when the delay coil in the video amplifier circuit becomes open. However, it is rare that an open delay coil occurs. Nevertheless, check the delay coil for an open circuit.

3 In areas where interference of ghost signals is present, the symptom will appear even if the set is operating properly. In this case, rotate the antenna until the symptom is eliminated or minimised. Changing the height and location of the antenna will also improve the reception. But the higher the antenna does not always mean a better reception.

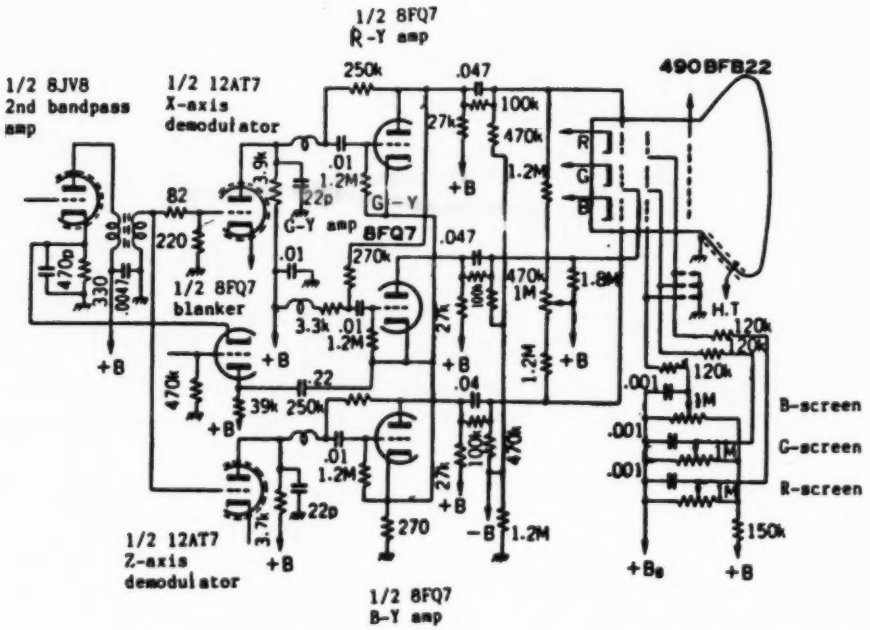


Fig. 31-1
Colour demodulator and substraction amplifier circuit

32 Fine colour noise

This symptom appears all over the screen during black-and-white reception.

Cause: Fine colour noise is caused by a misadjustment or a breakdown in the colour killer circuit. When the colour killer circuit is defective, the bandpass amplifier is not disabled during black-and-white reception. This produces fine colour noises on the screen.

TROUBLE-SHOOTING PROCEDURE

Adjust the colour killer control first and check whether the colour noise disappears. If it does, readjust the colour killer circuit to eliminate the colour noise during black-and-white transmission.

If the colour noise cannot be eliminated by adjusting the colour killer control, check the colour killer transistor (Q4) for a shorted emitter-base junction. Check also for open base or emitter resistors (R1, R2 in Fig. 32-1). When R1 or R2 is open, the collector voltage of the killer transistor increases. This enables the colour circuit even during black-and-white reception, thus colour noises appear on the screen. The collector voltage of Q4 is usually around 11 V DC during colour reception and around 5 V DC during black-and-white reception. Therefore, if the collector voltage of Q4 is around 11 V during black-and-white and colour transmission, any of the components mentioned above are defective.

Technical memo

To confirm the function of the colour killer circuit, observe the change in the collector voltage of the colour killer transistor while rotating the colour killer control. If the colour killer circuit is operating properly, the collector voltage will vary from 3 to 11 V DC (set the VOM at 50 V/DC range).

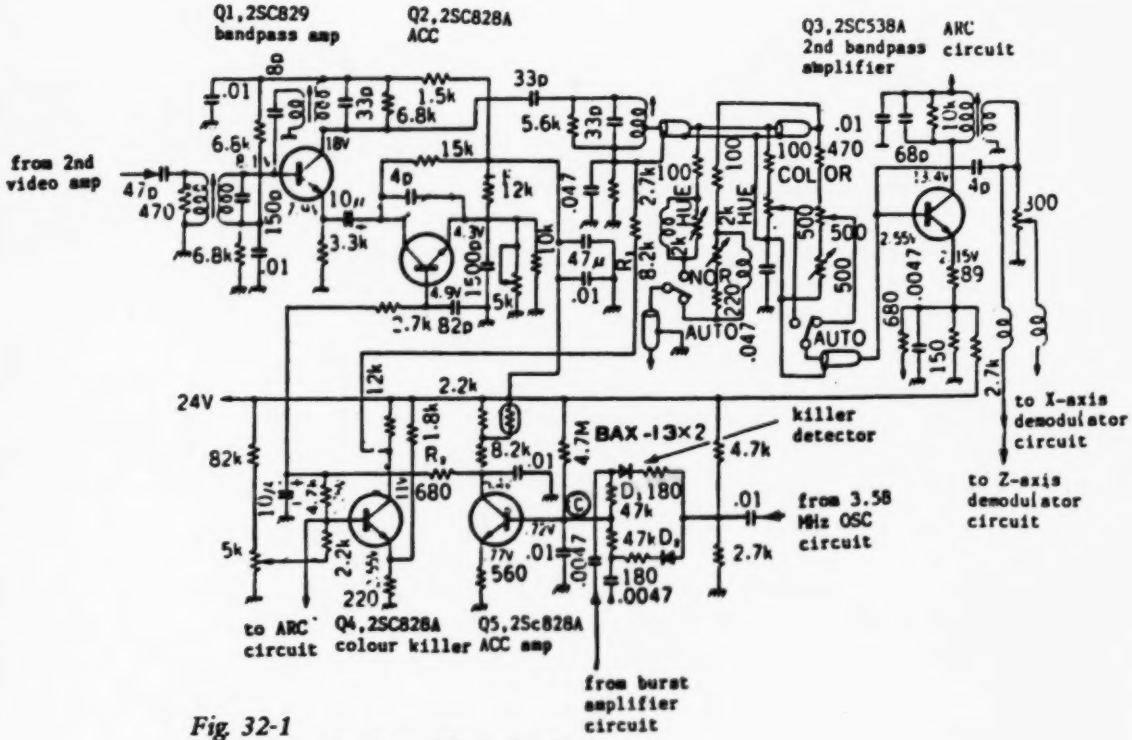


Fig. 32-1
Bandpass and colour killer circuit

33 Poor brightness

This symptom is characterised by a picture with insufficient brightness (dark picture) even when the brightness control is at maximum.

Cause: The following will cause a dark picture: 1) a decrease in the high voltage of the CRT due to a breakdown in the high voltage, horizontal deflection or power-supply circuit; 2) an increase in the cathode voltage of the CRT due to a breakdown in the video amplifier or in the ABL circuit; 3) a decrease in the first grid voltage of the CRT due to a breakdown in the horizontal pulse drive circuit; and 4) a decrease in the second grid voltage of the CRT due to a breakdown in the second grid circuit.

TROUBLE-SHOOTING PROCEDURE

Referring to the above causes, it is important to check the voltages of the electrodes of the CRT. First, check the B+ supply voltage, then the cathode, first, second grids and the anode voltages relative to ground. Exercise caution in measuring high-electrode voltages. Refer to Fig. 33-1.

Secure a circuit diagram or a service manual of the receiver for the correct electrode voltages of the CRT.

1 ***Measuring the electrode voltages of the CRT***

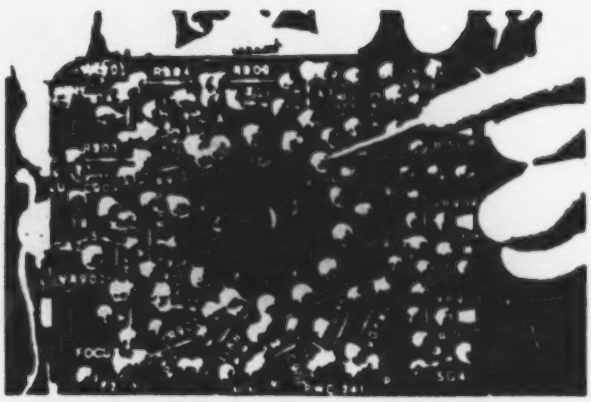
It is convenient to measure the CRT electrode voltages at the PC board attached to the CRT circuit, as shown in Picture 33-1. The normal electrode voltage varies with the CRT and the type of drive circuit used. As an example, for the colour subtraction drive, the supply voltages for the electrodes are as follows: between 130 and 160 V for the cathode, around 60 V for the first grid and around 600 V for the second grid. In measuring the electrode voltages, pay attention to the following: a) while measuring the cathode voltage, set the brightness control to minimum (darkest level) and check whether the cathode voltage is higher than the normal maximum value; b) check if the first and second grid voltages are lower than the normal values.

If the cathode voltage is higher than normal, trouble-shoot the video amplifier and the ABL circuits. Trouble-shoot the horizontal pulse amplifier circuit if the first grid voltage is low and trouble-shoot the second grid circuit if the second grid voltage is low.

The possible defective components are indicated with arrows in Figs. 33-2 and 33-3.

2 ***Trouble-shooting the high-voltage circuit***

Measure the CRT high-voltage supply with a high-voltage meter. Generally, around 24 kV is supplied to the anode. If the voltage is very low, check the horizontal output circuit. A decrease in the forward gain of the horizontal output transistor is usually the trouble.



Picture 33-1
Checking CRT electrode voltage

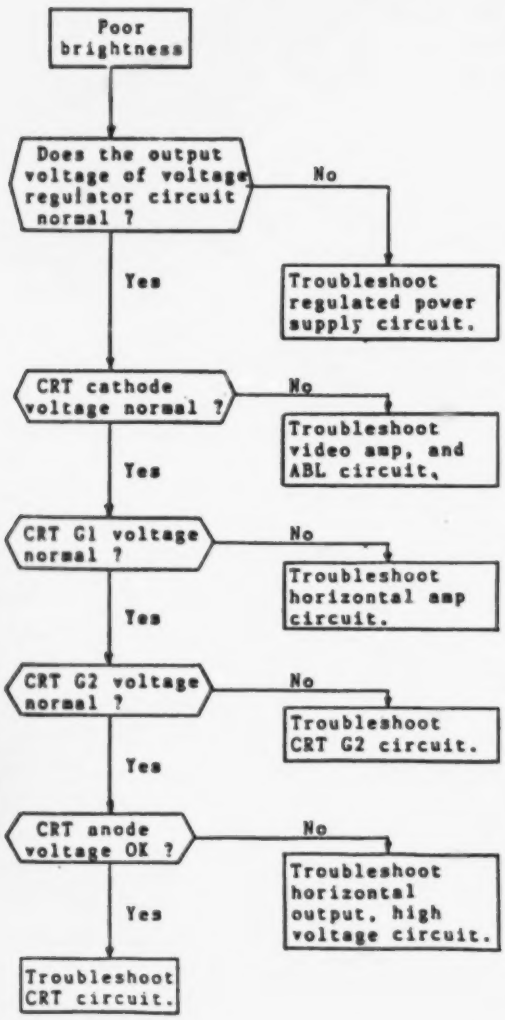


Fig. 33-1
Trouble-shooting flow chart for poor brightness

The most likely defective components are indicated with arrows in Fig. 33-4.

In some receivers a tube is used as a high-voltage rectifier. In this case, if the size of the raster varies as the brightness control is adjusted, replace the tube with a new one.

Technical memo

1 If the trouble is in the horizontal output circuit, the symptom is usually accompanied with insufficient raster width. A breakdown in the B+ voltage supply circuit is indicated by a decrease in the height and in the width of the raster. Refer to Symptom 11 for trouble-shooting the B+ power-supply circuit.

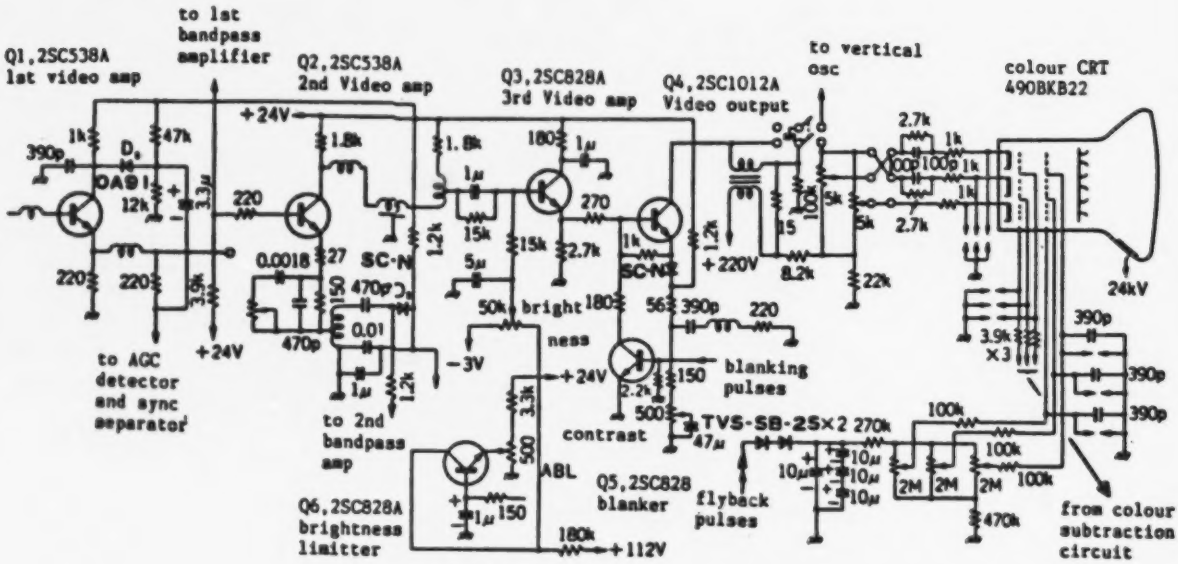


Fig. 33-2
Video amplifier and CRT circuit

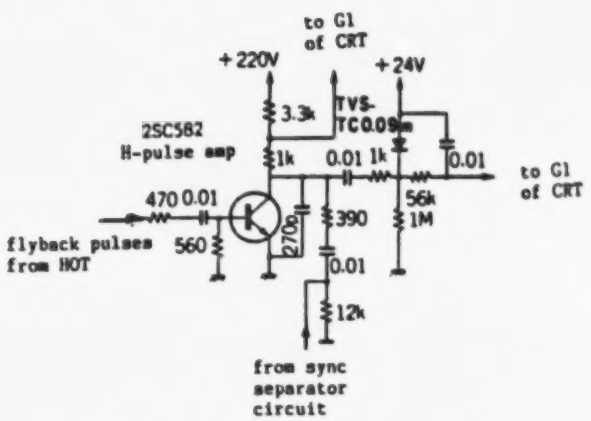


Fig. 33-3
Horizontal pulse amplifier circuit

2 The ageing of the cathode in the CRT (low emission) will also cause the symptom. But in this case, the white balance of the picture is also affected and the picture becomes bluish or greenish or out of focus.

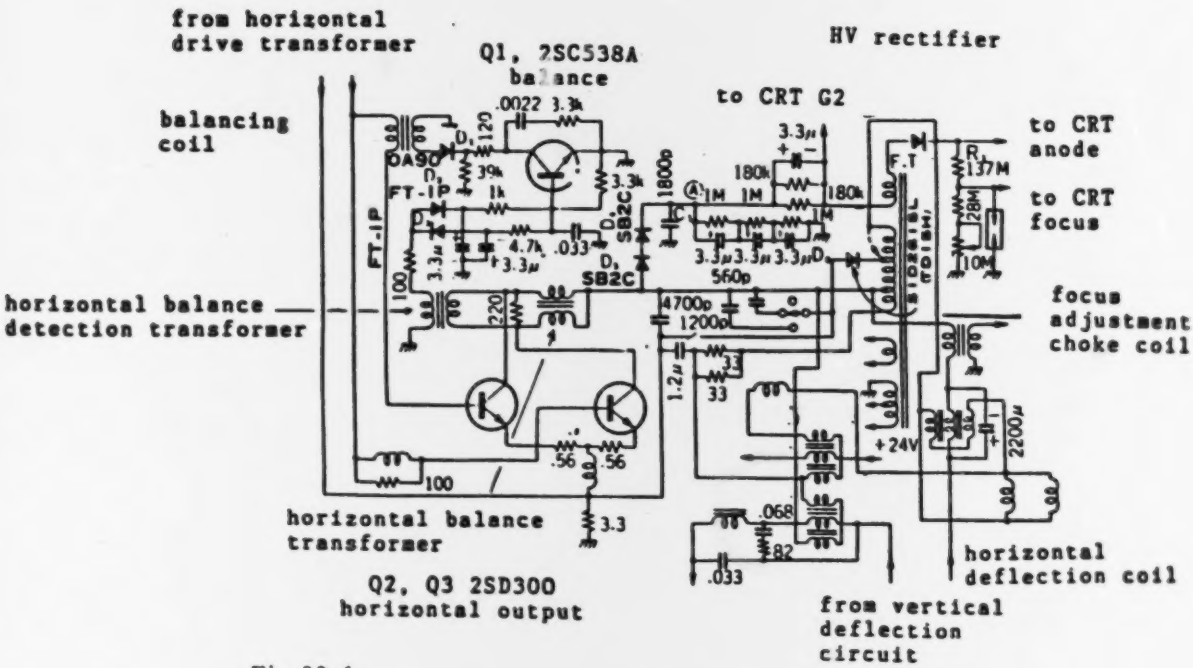


Fig. 33-4
Horizontal output and its surrounding circuit

34 A bright spot in the middle of the screen

There are two cases of this symptom. One is characterised by a bright spot that remains on the screen for a short period after the receiver is switched off. The other is characterised by the appearance of a bright spot in the middle of the screen when the receiver is on.

Cause: Case 1. The bright spot that remains on the screen for a period of time after the receiver is turned off is caused by the stored static charge in the aquadag coating of the CRT which is connected to the anode. The stored charge develops a potential between the cathode and the anode. This potential accelerates the electrons in the remaining space charge of the cathode towards the screen. Since the vertical and horizontal deflection circuits are disabled when the receiver is switched off, these electrons are accelerated towards the centre of the screen. This kind of symptom is mostly observed in old monochrome black-and-white receivers.

Case 2. If the anode voltage of the CRT is normal, a loss in the vertical and horizontal deflection results in a white spot in the middle of the screen when the receiver is on. Usually this is caused by loose plug connections of the deflection coils.

It is very rare that both the horizontal and vertical deflection circuits become defective at the same time.

TROUBLE-SHOOTING PROCEDURE

For case 1, connecting a spot killer circuit to the bias circuit of the CRT solves the problem. A spot killer circuit consists of a capacitor and a resistor. When the receiver is switched off, the stored charge in the capacitor will be supplied to the bias circuit of the CRT to counteract the effect of the stored charge in the aquadag on the remaining space charge of the cathode.

For case 2, check the continuity of the sockets of the deflection coils. It was mentioned that a simultaneous breakdown in the horizontal and vertical circuits is rare. Nevertheless, if it so happens, follow the trouble-shooting procedure for the loss of horizontal deflection and for the loss in vertical deflection.

35 Appearance of the retrace lines

This symptom is characterised by the appearance of slanted white horizontal lines (vertical retrace lines) on the screen.

Cause: The appearance of retrace lines all over the screen, as shown in Picture 35-(a), is caused by a breakdown in the vertical blanking circuit. The appearance of compressed retrace lines on the upper part of the screen is caused by a breakdown in the vertical deflection circuit.

TROUBLE-SHOOTING PROCEDURE

1 ***Retrace lines all over the screen***

Observe the wave-form at the base of the blanking transistor (Q4) in Fig. 35-1. If the circuit is operating properly, you can see a normal composite video signal, as shown in Picture 35-2. If you do not see the video signal, check for an open base resistor (R4, R5) and coupling capacitor (C1) in Fig. 35-1. If you see a normal video signal, check the condition of the blanking transistor (Q4) and for

(a) *Picture 35-1* (b)

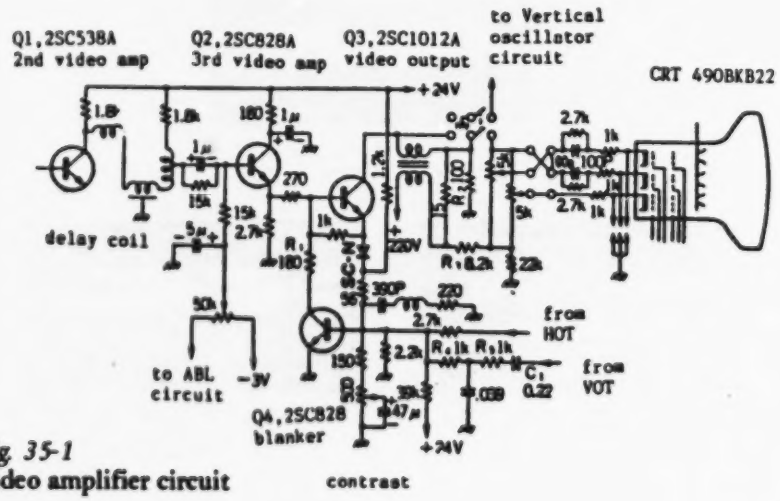


Fig. 35-1
Video amplifier circuit

an open collector resistor (R1). If all the components mentioned above are confirmed to be in good condition, check for open collector resistors (R2, R3) of the video output transistor.

Technical memo

a In checking for an open capacitor (such as C1), connect a capacitor that is in good condition in parallel to the suspected capacitor. The capacitance and rating of the capacitor to be connected in parallel should be equal to the suspected capacitor.

b The functional wave-forms of the circuit shown in Fig. 35-1 are shown in Pictures 35-3 and 35-4.

c When the collector resistors (R2, R3) in the video output circuit become open, the appearance of the retrace lines is accompanied with the brightening of the raster.

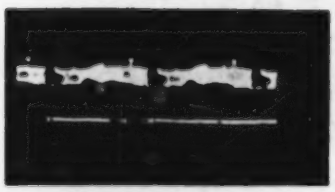
2 ***Compressed retrace lines on the upper side of the screen***

This symptom appears only when the vertical oscillator transformer or vertical output transformer has been replaced with a new one. The compressed retrace lines on the upper part of the screen are due to a vertical deflection circuit blanking period that is longer than the blanking period of the TV signal. Thus, to avoid this symptom, replace the output transformer with the same type.

Technical memo

If a transformer of the same type is not available, replace the peaking resistor (connected in series with the sawtooth generating capacitor) with a greater value. However, make sure that the value is not too large so as not to distort the upper linearity of the picture.

Picture 35-2
Base, blanker



Picture 35-3
Base, video output

Picture 35-4
Collector, video output

36 Poor focus

This symptom can be divided into three cases: poor focus, blooming and poor resolution.

Cause: ***1) Poor focus.*** This symptom is caused by a defective focus circuit, high-voltage rectifier circuit, high-voltage stabilising circuit or a defective CRT.

2) Blooming. This symptom is caused by a misadjusted white balance, a misadjustment in the ABL circuit or a defective video amplifier circuit. In any case, blooming occurs when the CRT beam current is excessive.

3) Poor resolution. This symptom is caused by a poor frequency response in any of the picture reproduction circuits (from the tuner to the video amplifier circuit). Ghost signals or a misadjustment of the fine-tuning circuit will also cause the symptom.

TROUBLE-SHOOTING PROCEDURE

1 *Poor focus*

In transistor TV receivers, check if the trouble can be solved by adjusting the focus control or by changing the position of the focus chip first. If the symptom remains, measure the focus voltage of the CRT. For bi-potential colour CRTs, 16 per cent to 20 per cent of the anode voltage is supplied to the focus electrode. For uni-potential colour CRTs, the focus voltage is around 100 V DC. If the focus voltage is not normal, check the condition of the focus circuit shown in Fig. 36-1.

If the focus voltage and the surrounding components of the focus circuit are normal, the CRT is defective.

If the horizontal output, HV stabilising circuit and the HV rectifier circuit use vacuum tubes, adjust the brightness control and observe the size of the raster and the focus of the image. If they vary while adjusting the brightness control, the high-voltage stabilising circuit is defective. However, if the size of the raster or the focus of the image remains constant, the trouble is in the focus circuit.

If the trouble is traced to the high-voltage stabilising circuit, replace the high-voltage stabilising tube with a good one. If the symptom remains, replace the high-voltage rectifier and the horizontal output tubes. Trouble-shoot the horizontal stabilising circuit only if the symptom remains after these tubes are replaced with new ones.

2 *Blooming*

Set the sub-brightness control at minimum and adjust the white-balance control. Check whether the blooming can be minimised. If so, set the average cathode current at the average value specified in the service manual by setting the brightness and contrast controls to maximum first, then adjust the automatic brightness limiter (ABL) control.

If the symptom cannot be eliminated, set the brightness control to maxi-

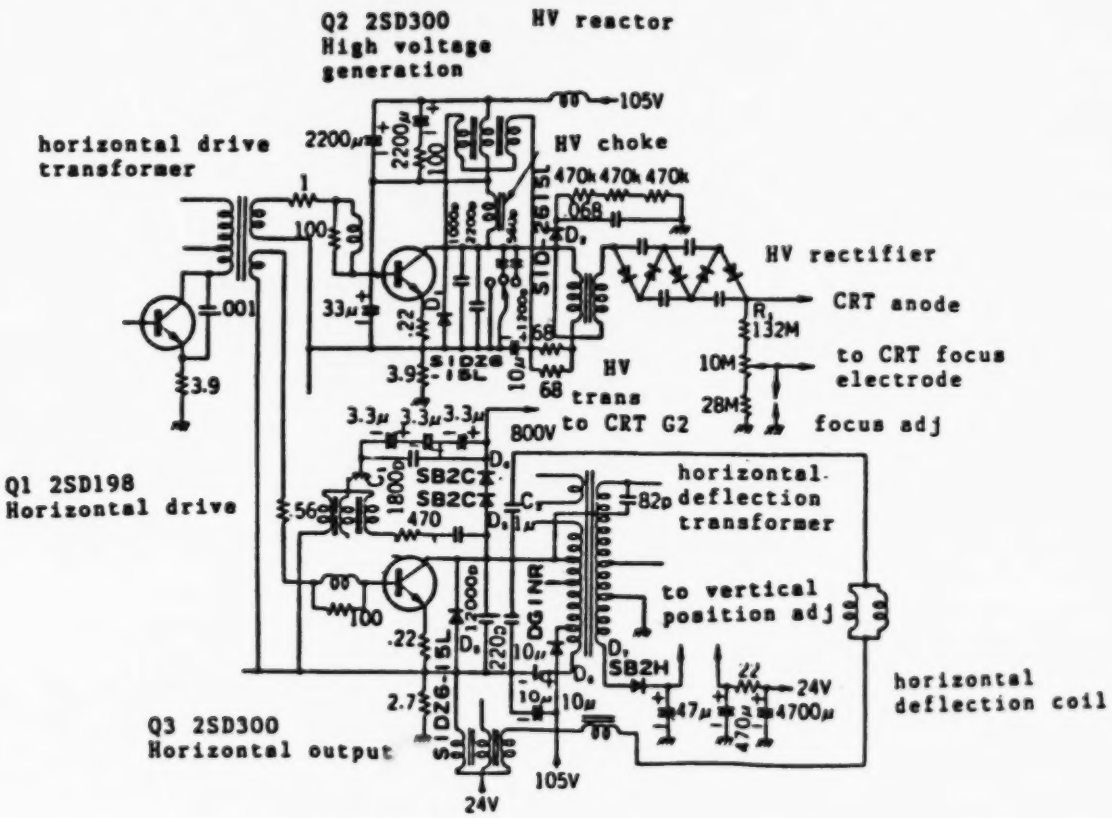
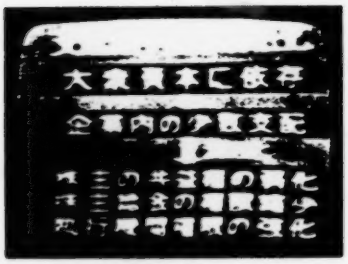
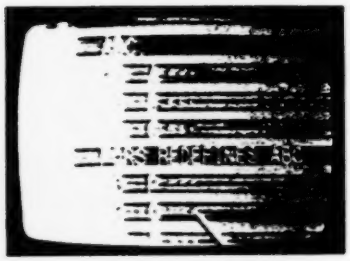


Fig. 36-1
Horizontal output circuit



Picture 36-1



Picture 36-2

mum and measure the cathode voltage. If the value is lower than the normal minimum cathode voltage, trouble-shoot the video amplifier and the ABL circuits.

3 ***Poor resolution***

Adjust the fine-tuning control first and check if any improvement in the resolution can be observed. If the resolution cannot be improved, delayed or ghost signals may be causing the symptom. Thus it is advisable to check the condition of the antenna system. However, check if the other channels have poor resolution. If not, then it is definite that ghost signals are causing the symptom. If all channels have poor resolution, the symptom may be caused by the narrowing of the bandwidth of the VIF circuit or by a trouble in the high- or low-frequency compensation circuits in the video amplifier circuit. But this is not common.

Reference

1 If the bandwidth of the VIF circuit becomes narrower or if the high-frequency response of the video amplifier circuit becomes poor, the right edges of the image on the screen are smeared (see Picture 36-1).

2 When the capacitance of the coupling capacitor in the video amplifier circuit decreases, the low-frequency components of the video signal are attenuated. This causes streaking lines to appear on the right edges of the images (see Picture 36-2).

37 Periodic raster movement

This symptom is characterised by a periodic vertical and horizontal movement of the raster. Sometimes flickering is also observed.

Cause: The symptom is caused by a modulated sync signal or ripples in the B+ supply, which affect the horizontal and vertical deflection.

Generally, in solid-state or IC receivers, a decrease in the capacitance of the filter capacitor or a breakdown in the voltage regulator circuit causes the symptom. A defective ADC (Automatic Degaussing Circuit) may also be the cause, although this is not common.

TROUBLE-SHOOTING PROCEDURE

1 ***Trouble-shooting the power-supply circuit***

Referring to Fig. 37-1, check the capacitance of the filter capacitor by connecting a new capacitor in parallel to it. If the movement of the raster stops, replace the filter capacitor. Other possible defective components that may be causing the symptom are indicated with arrows, as shown in Fig. 37-1.

Reference

In present transistor receiver sets, the AC voltage from the power line is directly rectified and supplied to the horizontal, vertical and sound output circuit. The supply voltage of the video reproduction circuits (tuner, VIF and video amplifier) and the sync circuits is taken from the pulse voltages generated by the flyback transformer (FBT) during retrace periods.

The supply voltage from the FBT is independent of the B+ voltage from the power supply. Thus the sync signal is not affected by ripples in the B+ voltage. If the defective receiver has the power supply setup described above, it is not necessary to check the power-supply circuit. However, the B+ line or the power-supply circuit has to be checked for receivers using the B+ voltage for the supply of the video reproduction circuits and the sync circuits.

2 ***Trouble-shooting the ADC***

If the thermistors or varistors used in the ADC circuit become shorted, current flow within the degaussing coil is continuous. In this case, the magnetic field produced by the degaussing coil will affect the paths of the electron beams and produce the same symptom. Thus if the power supply is found to be normal, disconnect one end of the ADC circuit and check whether the movement of the raster stops. If the movement stops, then the ADC circuit is defective. The ADC circuit is supposed to operate only for a very short period (not longer than the warm-up time of the CRT) right after the receiver is switched on.

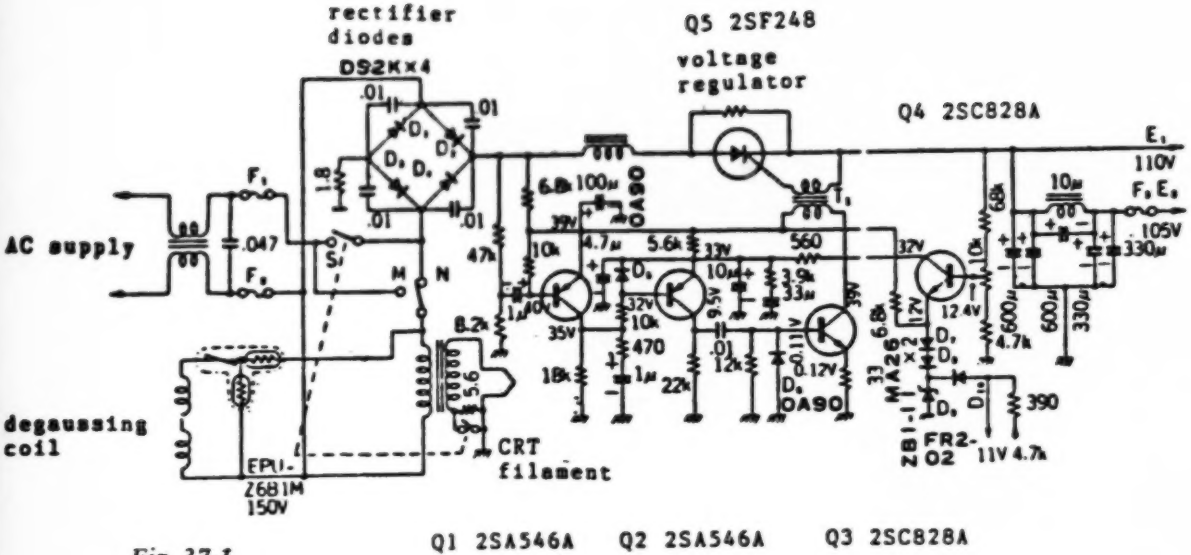


Fig. 37-1
Power-supply circuit

38 Black horizontal bars on the screen

These appear on the screen and roll slowly. There are three variations in this symptom. One is the continuous roll of the black horizontal bars (flickering). The second is the appearance of the bars only when there is sound (sound bar distortion). The third is the appearance of the bars only when it is windy (external antenna and cable moves) or when the receiver is physically tapped.

*Cause: **1) Flickering.*** This distortion is caused by a modulated video signal. A video signal modulated by an AC signal from the power output is shown in Picture 38-1. A breakdown in the regulator power supply (B+) circuit or a leak between the cathode and the filament of the CRT or the vacuum tubes, if they are used, will also cause the symptom.

2) Sound bar distortion. Misadjustment of the fine-tuning circuit or the VIF amplifier circuit is a possible cause. In a tube set, a defective tube and faulty contact in the tube socket are possible causes.

3) Bar distortion when it is windy or the set is tapped. A faulty contact point in the tuner or a partially opened antenna feeder cable may cause this symptom.

TROUBLE-SHOOTING PROCEDURE

1 ***Flickering***

For power-supply circuits similar to Fig. 38-1, check the condition of the filter capacitors (C2, C3, C4, C5) by shunting them with good ones. If the filter capacitors are in good condition, check the condition of the capacitor (C1) in the voltage stabilising circuit and the rectifier diodes (D1, D2, D3, D4).

In the case of a tube-type TV receiver, set the channel selector to a vacant channel or to the UHF position, then check if flickering occurs. If there is flickering, the trouble may be in the video amplifier, the power-supply circuit or the CRT itself. Otherwise, the trouble may be anywhere from the tuner circuit to the video detector circuit.

When the receiver is a tube type, always check the insulation between the filament and the cathode of the tubes or replace them with good ones to check their condition.

Technical memo

a In most cases, flickering in the picture is accompanied with a slow waving of the picture. This is caused by a sync signal modulated by AC ripples from the power supply. Picture 38-1 shows a modulated sync signal. Since the vertical sync frequency and the AC line frequency are the same or close, the rolling of the bar distortions is slow.

b It is very hard to detect a leak between the filament and the cathode of a tube with a VOM. If a tube is suspected, always replace it with a good one to check if it is causing the trouble.

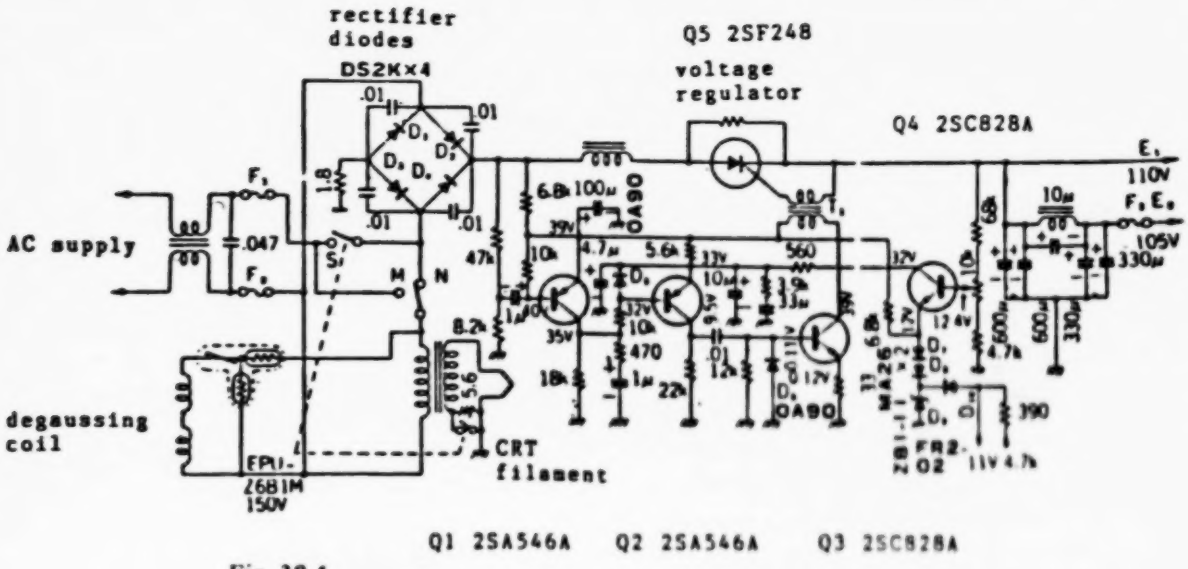
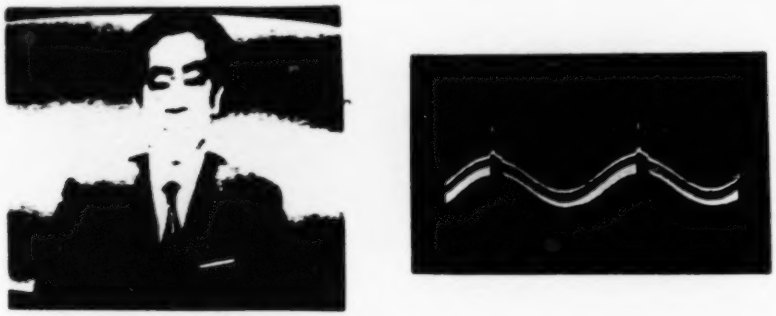


Fig. 38-1
Power-supply circuit



Picture 38-1
AC modulated video signal

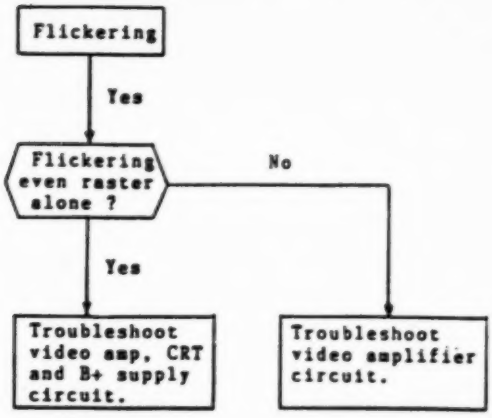


Fig. 38-2
Trouble-shooting flow chart for flickering

2 ***Sound bar distortion***

When the receiver is solid-state, the distortion can usually be eliminated by adjusting the fine-tuning control. In tube-type receivers, if the distortion cannot be eliminated by adjusting the fine-tuning control, set the volume to minimum and tap the tubes slightly in the video amplifier circuit (VIF and video amplifier). Check if the distortion appears when the tubes are tapped. In most cases, a faulty local oscillator tube in the tuner circuit or a defective tube socket is the trouble.

3 ***Bar distortion when it is windy or the set is tapped***

Jiggle the channel selector knob slightly with the handle of the screwdriver. If the distortion appears, the tuner has a faulty contact. If the distortion appears when it is windy, check the condition of the feeder cable connecting the external antenna and the set.

Technical memo

Cleaning the contacts of the tuner with a contact cleaner is not a permanent remedy. Avoid leaving excessive contact cleaner oil in the tuner contacts, because this will accumulate dust and worsen the situation.

39 Warped raster

This symptom is characterised by the warping of the picture, as shown in Picture 39-1. This is easily seen through a cross-hatch pattern on the screen. Notice that the lines are warped. The warping of the horizontal lines is more common.

Cause: This symptom is caused by a breakdown in the pin-cushion circuit.

TROUBLE-SHOOTING PROCEDURE

Receive a cross-hatch pattern on the screen and inspect if the horizontal or the vertical lines are warped.

Warped horizontal lines

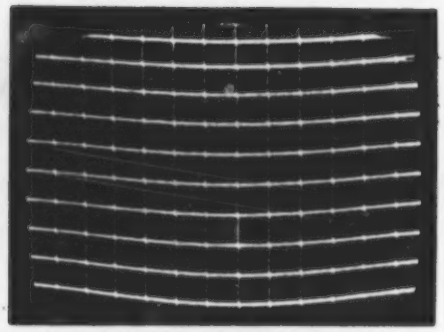
Adjust the pin-cushion tolerance adjustment controls such as the DPC AMP, DPC PHASE or DPC BAL if the circuit has such controls. If a circuit similar to Fig. 39-1 is used, check the horizontal warping adjustment transformer for an open circuit.

Warped vertical lines

For compensating circuits similar to Fig. 39-1, check the vertical warping compensation transformer or capacitor (C) for an open circuit.

Technical memo

Referring to Fig. 39-1, if the vertical or horizontal warping compensation transformer has an open circuit, in some cases the height of the raster becomes less or horizontal deflection is lost.



Picture 39-1
Warped raster

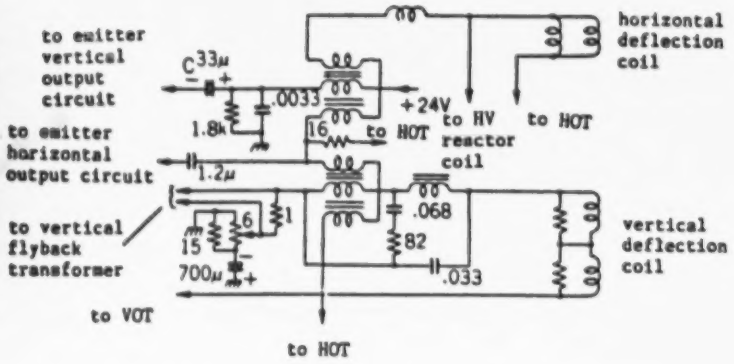


Fig. 39-1
Surrounding circuit of deflection coil

40 No sound

This symptom is characterised by the loss of sound reproduction. The video reproduction, however, is normal.

Cause: This symptom is caused by a trouble in the sound reproduction circuit (SIF circuit to the speaker).

TROUBLE-SHOOTING PROCEDURE

Use the flow chart shown in Fig. 40-1 as an aid in identifying the defective stage. Check the audio amplifier circuits first. If the audio circuits are operating properly, then trouble-shoot the SIF and the sound-detector circuits.

1 ***Trouble-shooting the audio amplifier circuit***

First, set the volume control to maximum. A fast method of checking the condition of the audio amplifier stages is to touch the base of the first audio amplifier transistor. A hum heard from the speaker indicates a normally operating circuit. The hum from the speaker in battery-operated receivers is not as loud as the hum heard from AC-operated receivers. So use a signal injector instead.

Nevertheless, if a hum is not heard from the speaker, locate the defective audio amplifier stage by measuring the voltages of the audio amplifier transistors (Q3, Q4, Q5) in the circuit in Fig. 40-2. Check for an open primary in the output transformer, open resistors (R5, R6, R7) or shorted capacitors and transistors.

A rusty or dusty earphone contact is also a common trouble. So plug in an earphone and jiggle it to make a firm contact. If you hear sound from the earphone, clean or (better) replace the earphone socket.

An open circuit in the primary of the audio circuit output transformer is a common trouble during rainy seasons due to air moisture. Intermittent loud noise can be heard from the speaker for a considerable time before the transformer develops an open circuit. This usually happens in seashore areas or automobile-crowded places.

2 ***Trouble-shooting the SIF circuit***

Measure the voltages of the transistors (Q1, Q2) in the SIF circuit shown in Fig. 40-2. Besides defective transistors, open collector resistors (R2, R4) and base resistors (R1, R3) are common troubles.

The condition of the SIF circuits and the FM detector circuit can be determined by measuring the voltage across C1 during channel reception. A reading of around 3 V DC indicates normal operation. Otherwise, the trouble most likely is in the SIF circuits, since it is rather rare for the FM detector to be defective.

3 ***Trouble-shooting a sound reproduction IC circuit***

Refer to the circuit in Fig. 40-3 for details. Fig. 40-4 shows the configuration

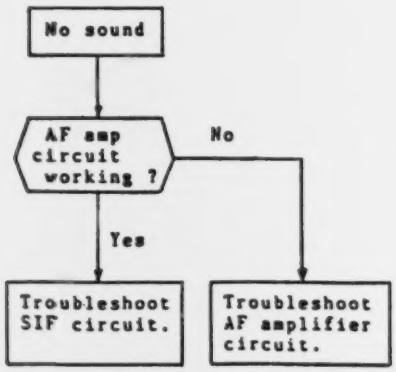


Fig. 40-1
Trouble-shooting flow chart for no sound

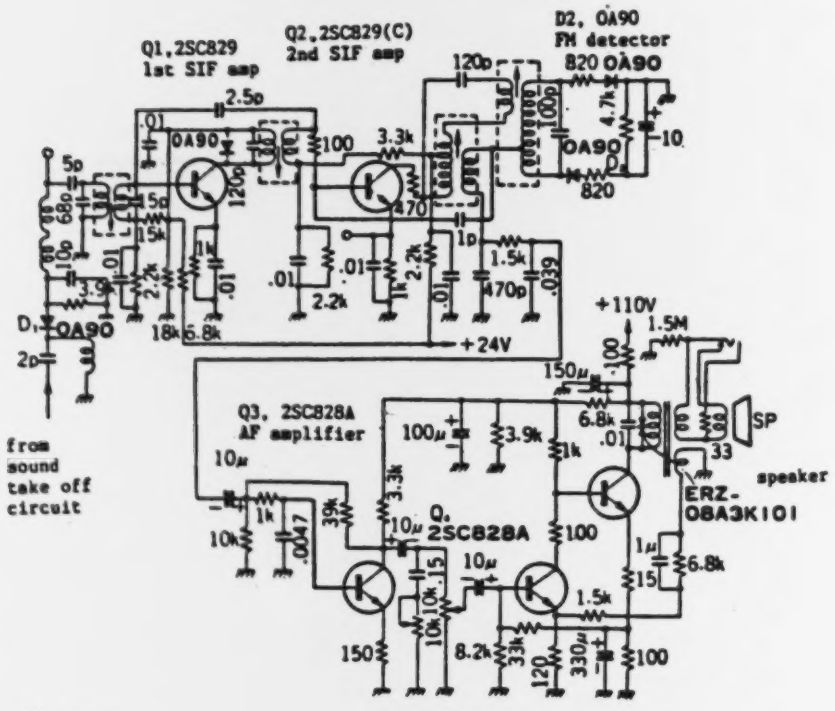


Fig. 40-2
SIF and audio amplifier circuit

of IC 301, the SIF amplifier, sound detector and the first stage of the audio amplifier circuit within the IC chip. The audio output is taken out from pin no. 10. Check for the presence of the audio signal at pin no. 10 with an oscilloscope or a signal tracer.

For reference purposes, the functional pin voltages and static resistances relative to ground are also given in Fig. 40-4. Most likely defective components are indicated with arrows in Fig. 40-3.

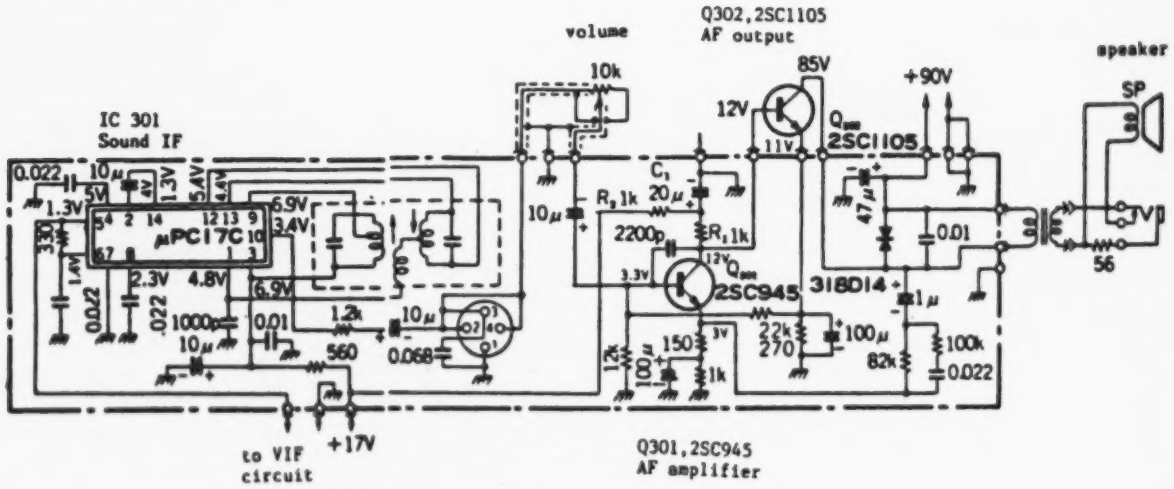


Fig. 40-3
IC SIF and audio amplifier circuit

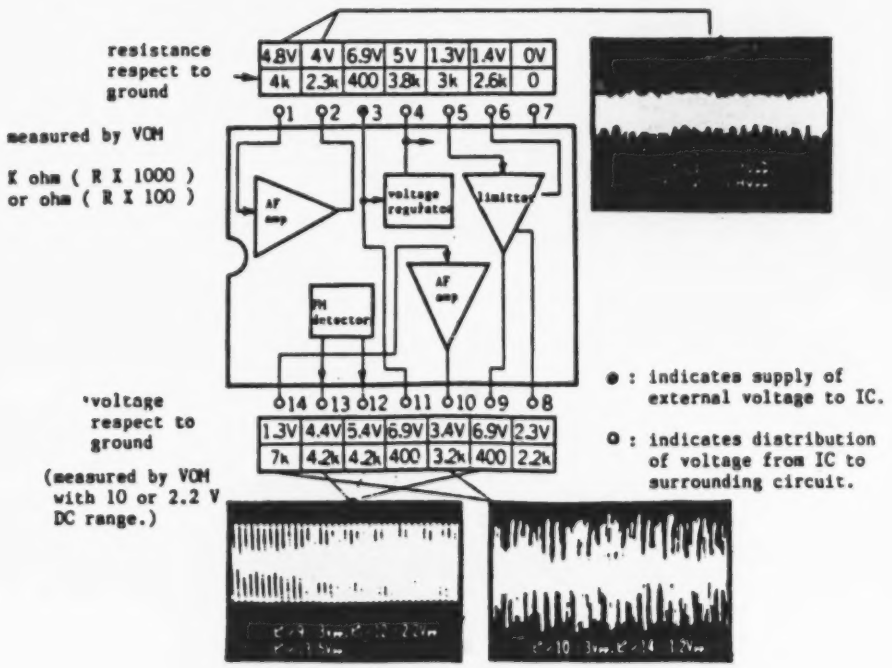

resistance respect to ground
4.8V 4V 6.9V 5V 1.3V 1.4V 0V
4k 2.3k 400 3.8k 3k 2.6k 0
measured by VOM
K ohm (R X 1000)
or ohm (R X 100)
AF amp
voltage regulator
limiter
AF amp
FM detector
voltage respect to ground
1.3V 4.4V 5.4V 6.9V 3.4V 6.9V 2.3V
7k 4.2k 4.2k 400 3.2k 400 2.2k
(measured by VOM with 10 or 2.2 V DC range.)
● : indicates supply of external voltage to IC.
○ : indicates distribution of voltage from IC to surrounding circuit.

Fig. 40-4
Normal voltage, resistance and wave-forms in IC 301

41 Weak sound

This symptom is characterised by weak sound reproduction and sometimes accompanied with sound distortion.

Cause: This symptom is caused by a defective sound reproduction circuit (anywhere from the SIF to the audio output circuit). Usually, the trouble is traced to the audio amplifier.

TROUBLE-SHOOTING PROCEDURE

Set the volume control at maximum and touch the base of the first audio amplifier transistor. If the hum from the speaker is weak, trouble-shoot the audio output circuit. If the hum is loud enough, trouble-shoot the SIF circuits.

1 ***Trouble-shooting the audio amplifier stage***

Check the voltage of the audio amplifier transistors (Q3, Q4, Q5) in the circuit in Fig. 41-1. Signal injection (see Picture 41-1) is a better method in locating the defective stage. If the signal injection method is used, start from the final stages towards the initial stages. If the stages in the audio amplifier are normal, the hum from the speaker is louder when the signal is injected at the initial stages. Refer to Picture 41-1.

2 ***Trouble-shooting the SIF circuit***

Usually, the quality of the sound is affected by a defective SIF circuit. Thus, if the volume is normal but the sound is distorted or is accompanied with a buzz, then check the SIF circuits. It is rare that a defective SIF circuit will cause the symptom. However, it is advisable to trouble-shoot the audio amplifier stage first. Nevertheless, check the voltages of the SIF transistors (Q1, Q2) in the circuit in Fig. 41-1. Common defective components are indicated with arrows.

Technical memo

1 When the primary winding of the audio output transformer becomes partially shorted, the sound becomes weak and distorted. It is hard to identify a partial short in the sound output transformer. Thus, after checking all possible defective components, replace the sound output transformer with a good one if it is suspected to be causing the symptom.

2 A leaky or shorted decoupling capacitor in parallel to the primary of the sound output transformer also decreases the audio strength. If it is suspected, disconnect one lead from the circuit and shunt it with a good one or measure its resistance to determine if it is shorted or leaky.

3 If the resistance of the base resistors (R1, R2, R3, R4, R5) of the audio output transistor (Q5) or audio amplifier transistor (Q3, Q4) increases, the gain of the stage decreases due to the shifting of the operating point of the transistor. As a result, the audio output becomes weak and distorted.

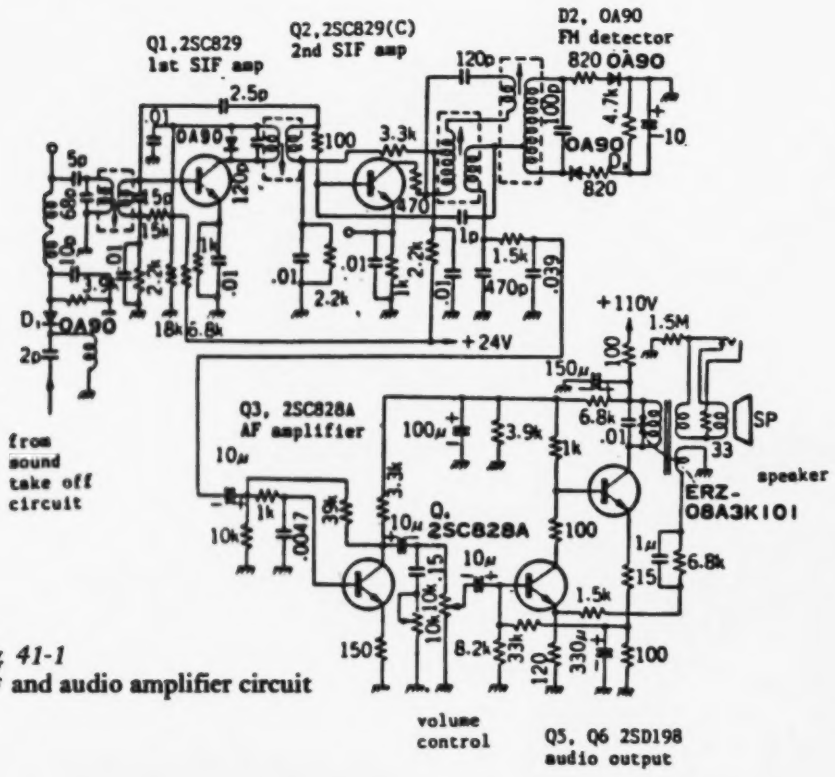
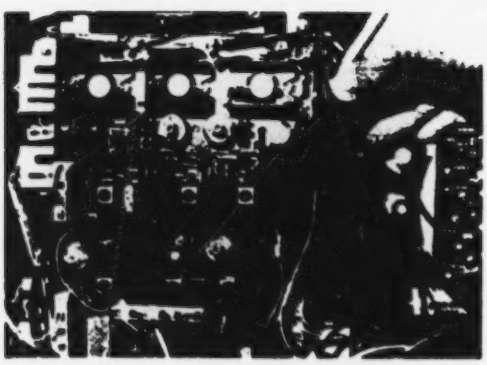


Fig 41-1
SIF and audio amplifier circuit



Picture 41-1

4 A defective volume control also causes the symptom. In this case, loud clicking sounds can be heard when the volume control is adjusted. Furthermore, the sound level is not varied linearly. Usually, the volume control is carbonised, rusty or dusty. Clean the volume control with a contact cleaner for temporary improvement of the audio level or (better) replace it with a good one. In using contact cleaners, wipe off excessive oil to prevent accumulation of dust.

42 Buzzing sound

This sound is heard from the speaker. There are three variations in this symptom: 1) buzzing sound in all channels, 2) buzzing sound in a particular channel and 3) buzzing sound during periods of bright images on the screen.

Cause: This symptom is caused by a misadjustment of the AGC control or by a misalignment of the sound-detector transformer.

TROUBLE-SHOOTING PROCEDURE

Adjust the fine-tuning control first and then the AGC control to check whether the buzzing sound can be eliminated. If the symptom remains or if the contrast of the picture becomes very poor when the buzzing sound is eliminated, adjust the core of the sound detector transformer to eliminate the buzz without affecting the contrast of the picture. Do not turn the core by more than 360 degrees. This adjustment usually eliminates the symptom. However, if this fails to solve the trouble, check the condition of the FM detector (D2, D3) in Fig. 42-1.

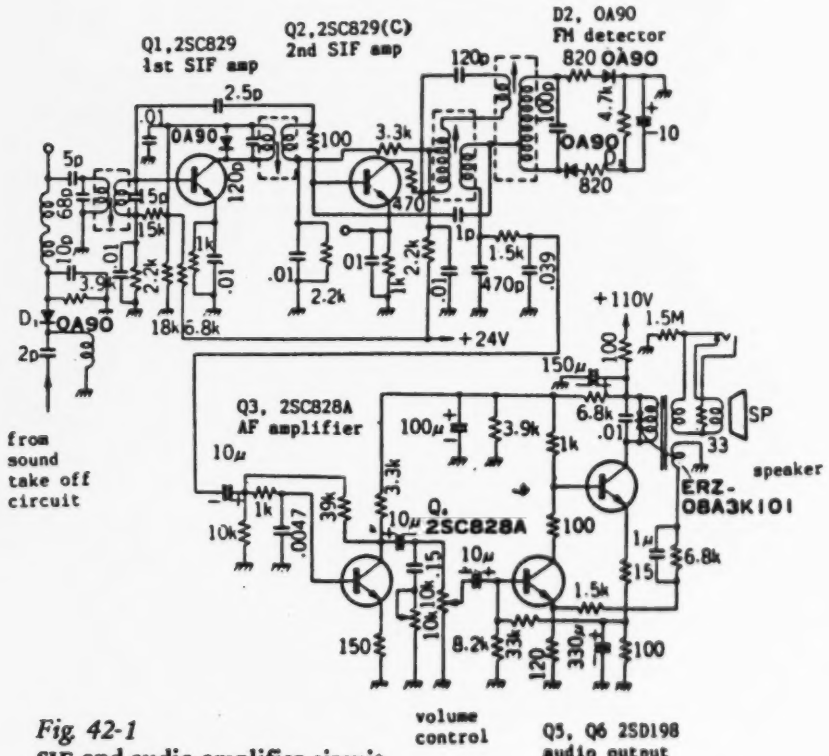


Fig. 42-1
SIF and audio amplifier circuit

Technical memo

A buzzing sound present in all channels is mainly due to the improper setting of the AGC control or misalignment of the sound detector transformer. On the other hand, a buzzing sound in a particular channel is mainly due to a poor fine-tuning adjustment. A misadjusted AGC circuit may also produce a buzzing sound when images with large bright areas are transmitted.

Reference

A buzzing sound is produced when the ratio of the level of the VIF signal and the SIF signal becomes small. The normal ratio of the signal strength between the VIF output signal and the SIF detector output is around 10:1 in the sound-detector output. The SIF signal is an FM signal, so its strength is constant, However, the VIF signal is an AM signal, so its strength varies with the picture information it carries. Thus, the ratio of the level of the VIF signal and the SIF signal is not constant. Even if the level ratio is maintained at 10:1 when the VIF contains picture information near the sync level (dark picture information), the ratio decreases when the VIF contains low-level picture information (bright picture information). Thus the buzz is heard when bright images are reproduced on the screen.

43 Distorted sound

This symptom is characterised by a distorted sound often accompanied with a buzzing sound.

Cause: A distorted sound accompanied with a buzzing sound is caused by a detuned circuit in the SIF amplifier and sound-detector circuit. A distorted sound alone is caused by a breakdown in the AF amplifier circuit.

TROUBLE-SHOOTING PROCEDURE

If a buzzing sound is present, rotate the core of the sound-detector transformer in either direction to a maximum of 360 degrees (do not rotate the core by more than one complete turn) to confirm if the buzzing sound can be eliminated. If the buzzing sound is eliminated or minimised, set the core in the position where the buzz is eliminated or minimised. If the symptom remains, trouble-shoot the AF amplifier circuit.

Trouble-shooting the AF amplifier circuit

The signal injection procedure is the most effective way to trouble-shoot the audio amplifier circuit. In this case, any audio signal producing devices such as an AF generator or the signal injector can be used as a source of the signal. The audio signals taken out from the lineout, record output or earphone jack of other audio sets can also be used as a source signal.

Inject a signal starting from the initial stages towards the output stages. Start from the base of the pre-amplifier transistor (Q3) to the base of the audio output transistor (Q5). Refer to Fig. 43-1.

After identifying the defective stage, locate the defective components with the aid of a VOM. In audio amplifier circuits, a shift in the operating point of the transistor usually causes sound distortion. Thus, the condition of the bleeder resistors (R1, R2, R3, R4, R5) in the base circuit and the insulations of the coupling capacitors (C1, C2, C3) must be carefully examined.

Technical memo

1 If both the sound detector and SIF transformers have to be aligned, adjust the sound-detector transformer first. Generally speaking, if the symptom is accompanied with a buzzing sound, retuning of the sound-detector transformer alone eliminates the problem in most cases. It is very rare that the SIF transformers have to be returned.

2 A change in the resistance of the bleeder resistors (R1 to R5) or a leak in the coupling capacitors (C1 to C3) shifts the operating point of the transistor involved. This causes sound-distortion. The level or strength (volume) of the sound output is also affected.

3 In a TV set which uses tubes for the sound output circuit, it is often observed that the sound output volume is normal when the set is switched on, but it be-

comes weaker or distorted after a time. This is caused by a defective sound output tube or by an open resistor in the circuit between the first grid and ground. In contrast, if the sound is distorted from the beginning, the trouble is a misalignment of the sound-detector transformer or a leak in the coupling capacitor in the grid circuit.

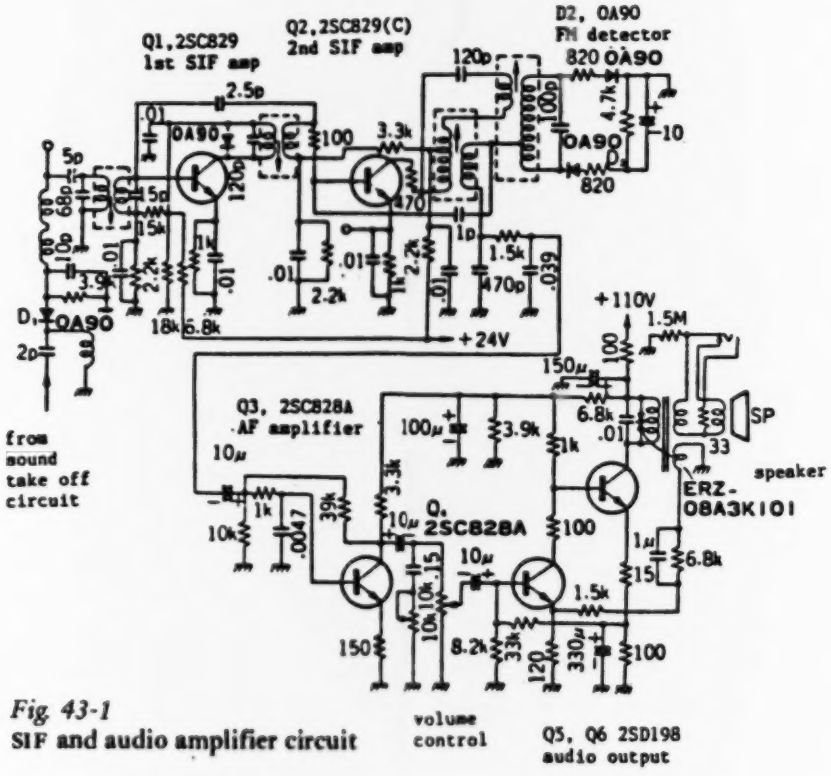


Fig. 43-1
SIF and audio amplifier circuit

44 Noisy sound

This symptom is characterised by irritating noise from the speaker. There are variations in this symptom. One is that the noise is produced only when the volume control is touched and the other is continuous noise.

Cause: A defective volume control produces a cracking sound when the volume control is touched. The continuous noise is caused by a partially open resistor or sound output transformer, an intermittent leak in a coupling capacitor, cold solder joints or a defective transistor.

TROUBLE-SHOOTING PROCEDURE

Ground the AC signals at the base of the audio output transistor with a capacitor (around 1.0 uF) and observe if the noise can still be heard from the speaker. If the noise is still heard, check the components in the audio output circuit. If the noise is eliminated after grounding the AC signals at the base, trouble-shoot the audio pre-amplifier and driver circuit. In most cases, a faulty contact in the volume control, defective pre-amplifier transistor, or a partially open collector resistor or output transformer are the troubles. See Fig. 44-1 for reference.

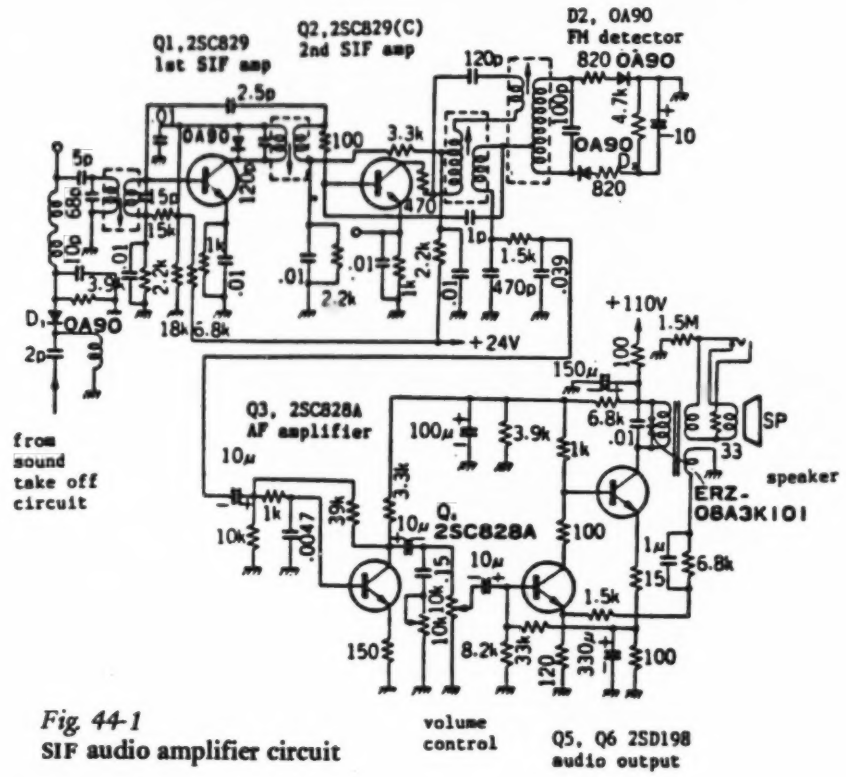


Fig. 44-1
SIF audio amplifier circuit

Technical memo

1 It is very hard to identify the cold solder joints. If they are suspected, tap the components one by one to identify the component with a cold solder joint. On the other hand, it is also effective to re-solder the suspected cold solder joints one by one. In this case, melt the joints considerably long together with a solder lead so that the leads of the component are solder-plated again. Do not use any other flux than the one included in the 60/40 soldering lead.

2 The use of the contact cleaner spray must be limited as much as possible. The oil component of the contact cleaner may gather dust together. This dirt becomes harmful to the circuit when it drives. Whenever a contact cleaner is used, wipe out the excess.

3 In applying the contact cleaning solution, spray it not only to the electronic but also to the mechanical parts. The faulty contact in a mechanical component will cause poor grounding and so it will produce an irritating noise.

45 Colour noise

This symptom is characterised by moving stripe colour noises that appear during the presence of audio signals.

Cause: This symptom is caused by the misadjustment of the fine-tuning circuit, misalignment of the sound traps in the VIF circuit or of the sound trap after the video detector circuit.

Countermeasures: Adjust the fine-tuning control first. If the set has an AFT button, set it to manual mode and readjust the fine-tuning. If the colour beat cannot be eliminated, the breakdown of a sound trap in the VIF circuit or a misadjustment in the sound trap may be the trouble. In this case, you must readjust the traps.

Reference

In colour reception, the video detector output consists of the luminance (Y) signal, chroma signal, a beat signal produced by the picture and sound carriers and a beat signal produced by the difference of the chrominance and sound signals. If these signals are not trapped, the video amplifier and the bandpass amplifier will amplify it. The beat amplified by the video amplifier produces the distortion on the screen.

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